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THE MODEL ENGINEER

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SMOKE RINGS

The S.M.E.E. at the "M.E." Exhibition

● AT THE forthcoming MODEL ENGINEER Exhibition, the Society of Model and Experimental Engineers will have a stand in connection with which there will be a display of models running under air, a special display of locomotives and a test-bench for steam and petrol engines. Mr. A. L. Hutton has been appointed organising manager on behalf of the society, and members who have :—(a) locomotives, (b) models capable of running on compressed air and, (c) any other models of interest, are asked to get into touch with Mr. Hutton at 4, Charldane Road, New Eltham, S.E.9, Telephone No. Eltham 2537, as early as possible.

In connection with the test bench, it is anticipated that members of other clubs may wish to have their engines tested, and arrangements for this can be made upon application to Mr. Hutton.

Owing to the layout of the Exhibition this year, it is regretted that the society's track cannot be accommodated.

Members who are willing to volunteer to act as stewards on the society's stand and exhibits are asked to communicate with Mr. Hutton.

Racing Traction Engines

● ON SUNDAY, June 24th, we visited a large grass meadow near Nettlebed, Oxon, to witness the very rare occurrence of a race between two traction engines. The contestants were : *Eileen*, a Wallis & Steevens general-purpose tractor, and *Old Timer*, a similar engine of Marshall design and build ; the former belongs to Dr. G. Romanes, of Bray, Berks, and the latter to Farmer Arthur Napper, of Appleford, Berks. The prize was a firkin (nine gallons) of beer. The scene of the race was chosen because it is roughly half-way between Bray and Appleford, by way of the Maidenhead-Oxford road.

The race was started by Lord Nuffield, and immediately *Eileen* gained the lead, and she continued to gain it for most of the half-mile run out to the turning-point ; after turning, however, she failed to keep up with *Old Timer*, and she eventually lost the race by some five lengths.

It was all quite exciting, very homely and cheerful ; we do not remember ever having seen traction engines moving at such a speed ; one elated spectator estimated it at 12 m.p.h. which is probably not far from correct. Both engines were "flat out" on both the outward and inward runs, though the failure of *Eileen* to maintain her lead surprised everybody ; we think she must have developed some defect somewhere in her mechanism, because she obviously had plenty of steam, whereas *Old Timer* appeared to have considerable difficulty in getting up steam before the race, but maintained it well during the run.

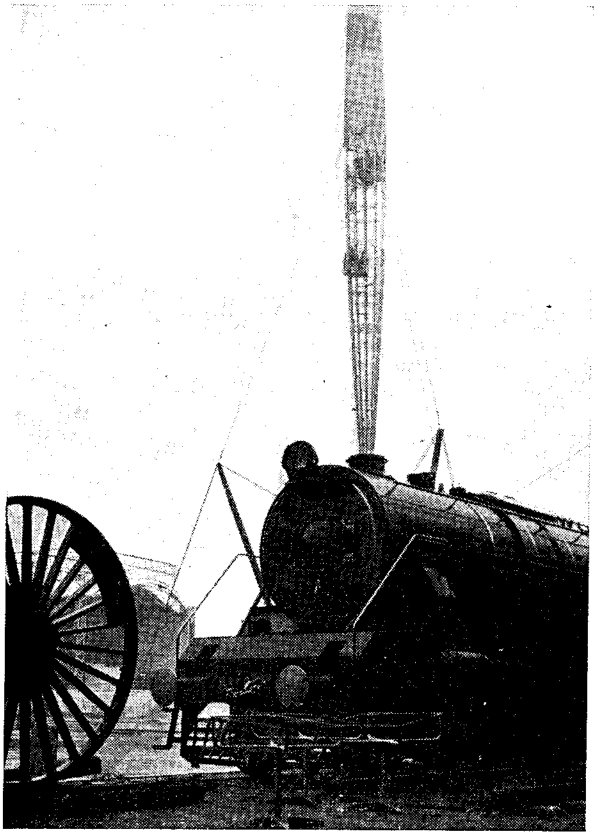
We would like to see another contest of this kind ; there is something about it that is extremely attractive and enjoyable.

The Bookworm Filing System

● WITH REFERENCE to the note published in our issue of June 28th, we have been asked to state that the Bookworm Files mentioned can be obtained from Bookworm Supplies, 229-230, Strand, London, W.C.2.

Scene at the Festival

● THE PHOTOGRAPH reproduced on this page shows a scene which, to a photographer, is well-nigh irresistible! The locomotive front end belongs to the fine 2-8-2 engine No. 8350, one of a series being built by the North British Locomotive Company for the Indian Government Railways. The particular viewpoint from which the photograph was taken produces an effect which may, perhaps, be best described as a skylonic exhaust!



The fine wheel on the left, however, is of considerable historic interest; it is one of a pair exhibited complete with crank-axle, and they mystify a surprising number of visitors who seem never to have heard of the G.W.R. Broad Gauge! But the main significance of those wheels is that, at the Great Exhibition in 1851, the G.W.R. exhibited the famous broad-gauge 8-ft. singlewheeler *Lord of the Isles*, then the latest of her celebrated class. After the exhibition, this engine went into traffic and remained at work until 1892, when the G.W.R. was finally converted to standard gauge. *Lord of the Isles* was then kept at Swindon as an exhibit; she was lent to the World's Fair, Chicago, and to the Earl's Court Exhibition, London. However, dire tragedy overtook her in 1906, when the G.W.R. authorities came to the conclusion that they could not spare space for her any longer; they offered her to South Kensington Museum, but the offer was reluctantly refused, due to lack of space. So Swindon consigned this splendid engine to the scrap-heap. Part of her valve-motion was presented to the Westbourne Park Technical Institute, and Swindon kept her crank-axle and driving-wheels, which are now all that remains of the once-celebrated locomotive and have been lent by British Railways to the South Bank Exhibition.

First Again?

● AFTER SATISFYING ourselves that THE MODEL ENGINEER was first in the field with an article on "Wireless Telegraphy" for amateurs, we were brought up with a jolt the other day, while looking for something else(!), to discover that the issue for February 9th, 1905, contained an article entitled "The Gas Turbine." Apparently, some of the devices which we fondly imagine as "modern" are not quite so modern as might be supposed. So far as the gas turbine is concerned, we are unable to state who invented it, and we are more inclined to think that it was, like many other things, never actually *invented*. But we are quite prepared to believe that most people who are not technical experts would associate it immediately with Air-Commodore Sir Frank Whittle!

The "M.E." article of 1905 was not, in any sense, constructional; it gave a very brief statement of the problems to be solved in designing a successful gas turbine, and then gives extracts, with diagrams, from a description published in a Swiss periodical in August, 1904. What is interesting to note is that the general principles applied to the machine described are practically the same as those we know today. Although a compressor is mentioned, no details of it are given; but the article leaves no doubt that the essential features of a gas turbine were clearly foreseen 46 years ago. In these circumstances, it is remarkable that not until about 15 years ago was any intensive development of gas turbines in progress. But THE MODEL ENGINEER seems to have been the first periodical to bring the idea of a gas turbine to the notice of amateurs.

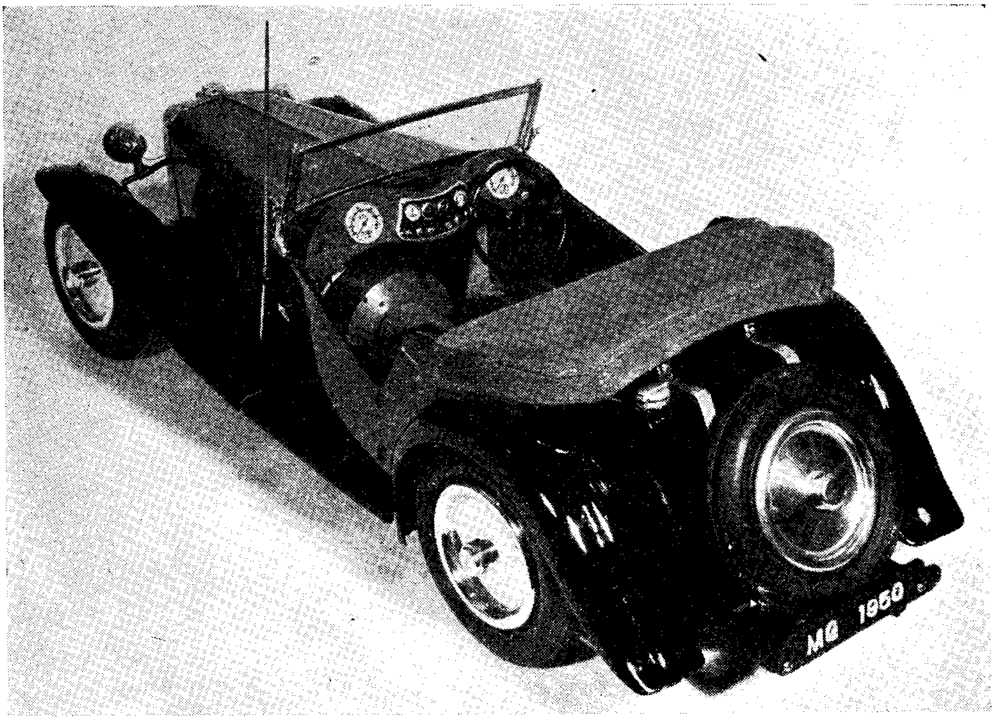
Corrigendum

● We wish to assure all readers that, in spite of the dates which have appeared more than once in the "M.E. Diary" during recent weeks, the MODEL ENGINEER Exhibition *will* be open on August 24. The only date which should have been omitted is, of course, August 26.

A $\frac{1}{8}$ Scale Model M.G. Midget

by L. A. Hancox

FOR many years I have been interested in building models, scale model aircraft and boats, but recently I felt the urge to build a power-driven model car. As I have been the proud possessor of two M.G. cars during my life, my choice automatically turned to a scale model M.G. Midget, Series T.C. Not being very interested in sheer speed, a Mills 1.3 c.c. engine was to provide the motive power.



From any angle the model looks correct to scale and when eventually wire wheels are fitted, it will be hard to distinguish from the real thing

With a view to collecting information to enable a true scale car to be made, I approached Morris Cars Ltd. regarding details, etc. They very kindly supplied me with a G.A. drawing of a "Midget." This drawing turned out to be so large, I had to set about reducing it to the size I needed, and as it turned out, came to $\frac{1}{8}$ scale.

The choice of material was dictated by my own capabilities and the scope of my workshop. This is equipped with an old Adams $2\frac{1}{4}$-in. plain lathe and the usual collection of hand tools, so wood it had to be, apart from the mudguards, which I decided could only be made from metal.

With great fear and trepidation I began making front and rear wings—my very first attempt at "metal bashing." Making wooden formers the inside shape of the wings and using 22-s.w.g. soft brass sheet, the job was started. After many hours of patient beating all four wings were produced. This was, in my estimation, the worst job finished.

Turning to the chassis, side members of the correct outline were cut from $\frac{1}{4}$-in. ply. An X type cross brace was cut out, glued, and pinned in place. The body floor was cut from $\frac{1}{8}$-in. ply, glued and pinned to the top of the chassis side members—thus giving a box structure which turned out to be very strong. (Fig. 1.)

The axles being run in ball-races required the front end of the chassis to be counterbored to receive $\frac{1}{4}$-in. ball-races, which are retained in place by a cover plate. As the rear axle comes above the chassis, the rear ball-races were fitted in special housings, glued, and screwed to the chassis, bringing the axle to the correct height. (Fig. 2.)

An engine mounting was made in the form of a $\frac{1}{8}$-in. ply platform, glued, and pinned to the chassis, and the engine mounted on the correct line.

The making of a flywheel, centrifugal clutch and transmission shaft was next started. The flywheel, turned from mild-steel, was fitted with two shoes made from Capesco and the clutch drum was turned from dural bar. An extended flywheel retaining-nut with a spigot was made to carry the two miniature ball-races on which the clutch drum revolved. (Fig. 3.)

The propeller shaft was made from $\frac{5}{16}$-in. dural bar, threaded $\frac{1}{4}$ in. B.S.F. at the front end to fit the clutch drum, and turned down to a shoulder at the rear end to fit a thrust ball-race which was fitted in a housing across the chassis.

Fitting everything into place and using steel bevel gears of 2 : 1 ratio on the back axle, the four wheels, which are standard " 1066 " $3\frac{1}{2}$ in., were secured on the axles and everything was ready to test the clutch.

Starting the engine, the clutch picked up smoothly and all ran well.

The main bodywork was now commenced. First, the main bulkheads were cut from $\frac{1}{8}$-in. and $\frac{3}{16}$-in. ply. Four bulkheads were needed, one behind the radiator, one at the rear of the bonnet, the back of the seats, and the rear of the body. The two body sides from bonnet to rear end were cut from $\frac{1}{16}$-in. ply to the correct outline. These two sides were next pinned and glued to formers. The corners at the rear of the body were fitted with square sections, then sanded to shape. The two rear mudguards were now screwed to the rear body former and the one behind the seat, so that the whole of the body from scuttle rearwards can be removed from the chassis in one piece.

The bonnet was now taken in hand. Formers at the radiator end and at the scuttle were cut, the two sides up to the curve were glued and pinned to these two formers and the curved edge was made by gluing $\frac{1}{16}$ in. square strips and then sanding to shape. Stiffeners were fitted inside the length of each side. The whole assembly snaps into place and is held by two spigots going through the body floor and retained by two wire spring clips. This method allows the bonnet to be removed for engine starting and adjustment, then snapped into place. The radiator presented some difficulty at first, but was finally built up from $\frac{1}{16}$-in. ply on a $\frac{1}{8}$-in. ply back, cut out to allow air to flow through for engine cooling.

Two seat cushions and the seat back were made by cutting and sanding Sorbo rubber to the correct profile, gluing the rubber to $\frac{1}{16}$-in. plywood bases and then covering with red leather. Before cementing the leather to the rubber, lines were pressed into the leather by using the back of a hot kitchen knife—these lines represent the stitching in the upholstery. The interior of the cockpit was also covered in the same red leather and scraps of felt glued to the floor to represent carpets.

The windscreen follows full-size practice in

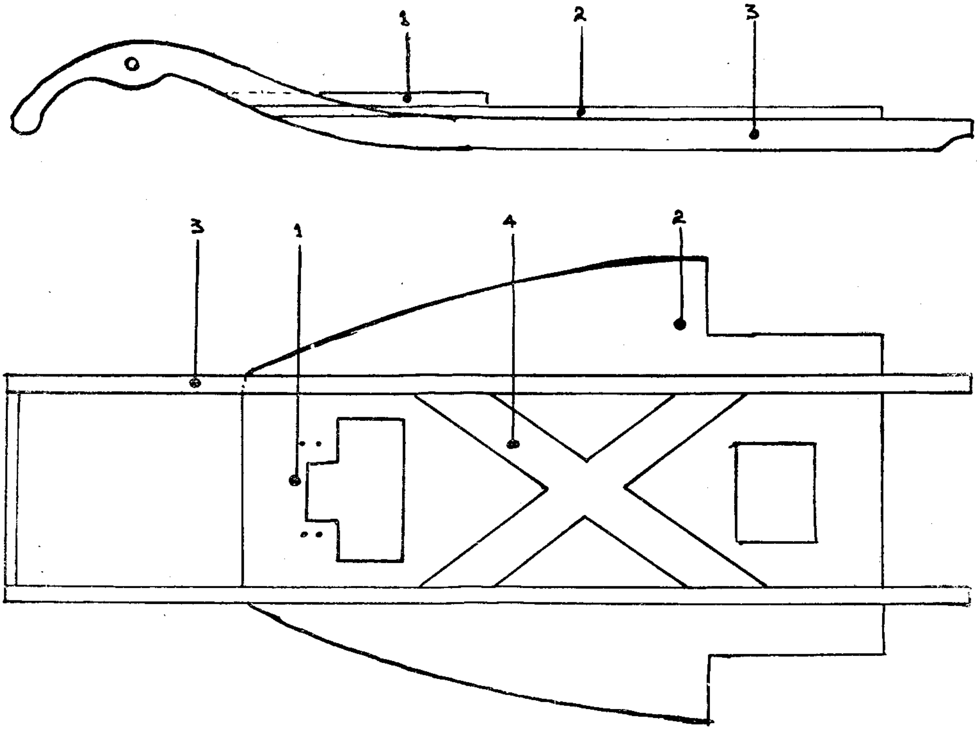


Fig. 1. Chassis, engine mount and body platform. 1, *Engine platform* ; 2, *Body floor* ; 3, *Chassis* ; 4, *X cross brace.*

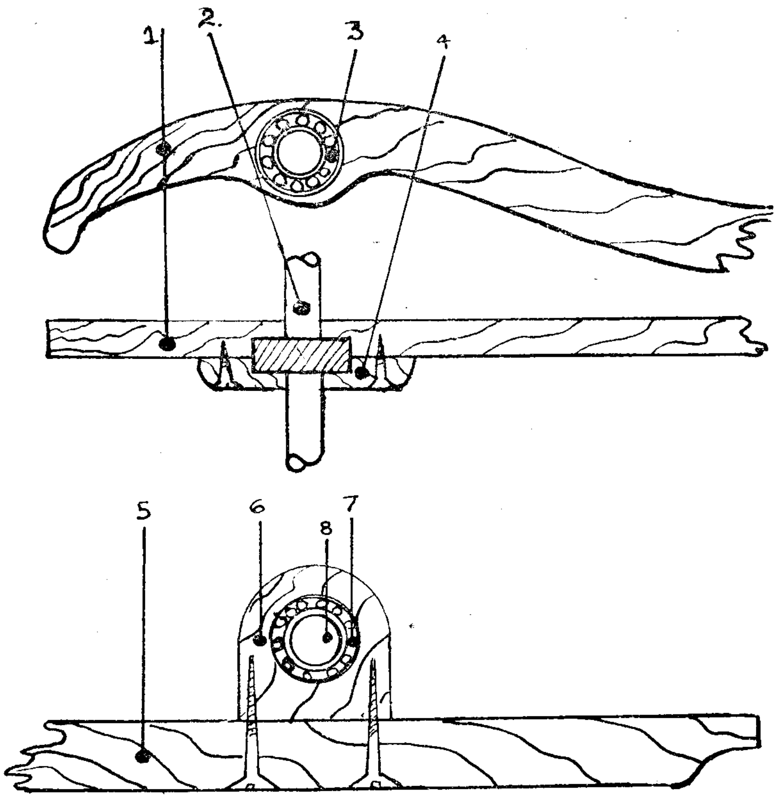


Fig. 2. *Front and rear axle bearings.* 1, *Front end chassis* ; 2, *Front axle* ; 3, *Ball-race* ; 4, *Cover plate* ; 5, *Rear end chassis* ; 6, *Ball-race housing* ; 7, *Ball-race* ; 8, *Rear axle*

that it is hinged and folds flat. First the two small side supports which are secured to the body were filed to shape from $\frac{1}{8}$-in. sheet copper, the radial slots were cut and the pivot and securing holes were drilled. Next, the windscreen frame was bent up from 10 thou. sheet copper to fit a screen made from $\frac{1}{16}$-in. Perspex. Side members of $\frac{1}{8}$-in. copper were soldered to the frame and the two pivots and two clamping-screws soldered into place. Two wing-nuts tapped 8 B.A. were made from sheet brass and filed to correct shape. Finally, two snap fastener pillars as used on model aircraft were sweated to the top of the two side members for the hood attachment. The pivot arms were secured to the body by three 8 B.A. countersunk screws going through the scuttle and into a metal plate, making the whole assembly rigid.

Turning to the dash, the instruments and instrument panel were made. The two larger dials, rev. counter and speedometer, $\frac{1}{2}$ in. in diameter, were turned from dural rod, a paper dial and Perspex front were secured in place and the instruments fitted to the dash by spigots left on the rear face of the dials.

The centre instrument panel on the full-size car holds :—ammeter, oil pressure gauge, head and side light switch, horn button, starter, choke, ignition warning lamp, and four other switches. All these had to be made to $\frac{1}{8}$ scale. This was where my old Adams lathe came into its own, as it has a collet mandrel. The two instruments, horn button and head and side light switch, were fairly simple, they are $\frac{3}{16}$ in. diameter and were soon turned from dural rod. The other items were a bit more tricky, but were finally turned from $\frac{1}{8}$-in. dural rod and filed. The main panel is cut from 18-s.w.g. aluminium sheet and all the instruments secured to this panel by tiny spigots left on the rear face of all the switches, etc. The whole panel was secured to the dash by four very small screws.

The steering wheel was made up by turning the column and half the boss from brass rod, cut-

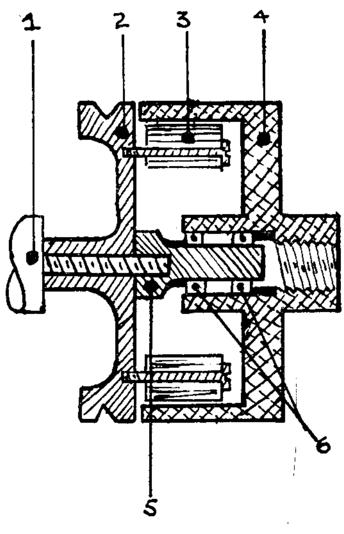
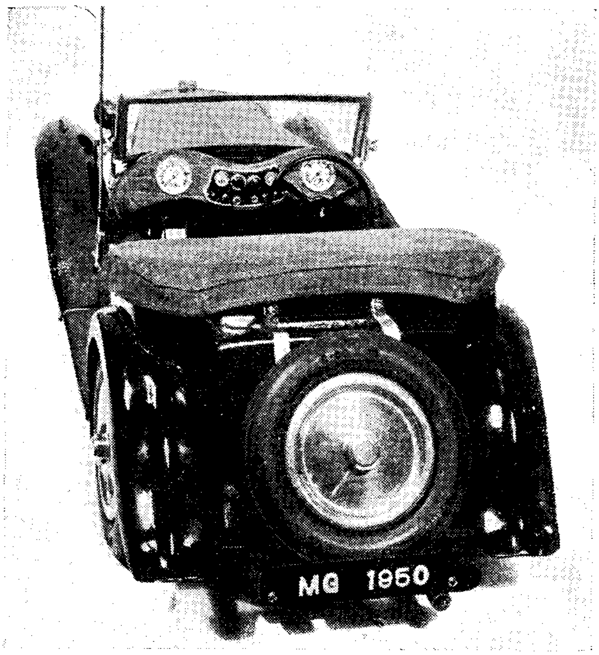


Fig. 3. *Flywheel and clutch.* 1, *Engine shaft*; 2, *Flywheel* (*steel*) ; 3, *Clutch shoe* (*Capesco*) ; 4, *Clutch drum* (*dural*) ; 5, *Flywheel nut* (*steel*) ; 6, *Miniature ball-races*

ting the spokes from sheet brass and clamping them between the bottom half boss and the top half, then sweating the whole up solid. The outer rim was shaped from $\frac{1}{8}$-in. copper rod and soldered to the outer tip of each spoke. This gives a replica of the solid spring-spoked wheel.

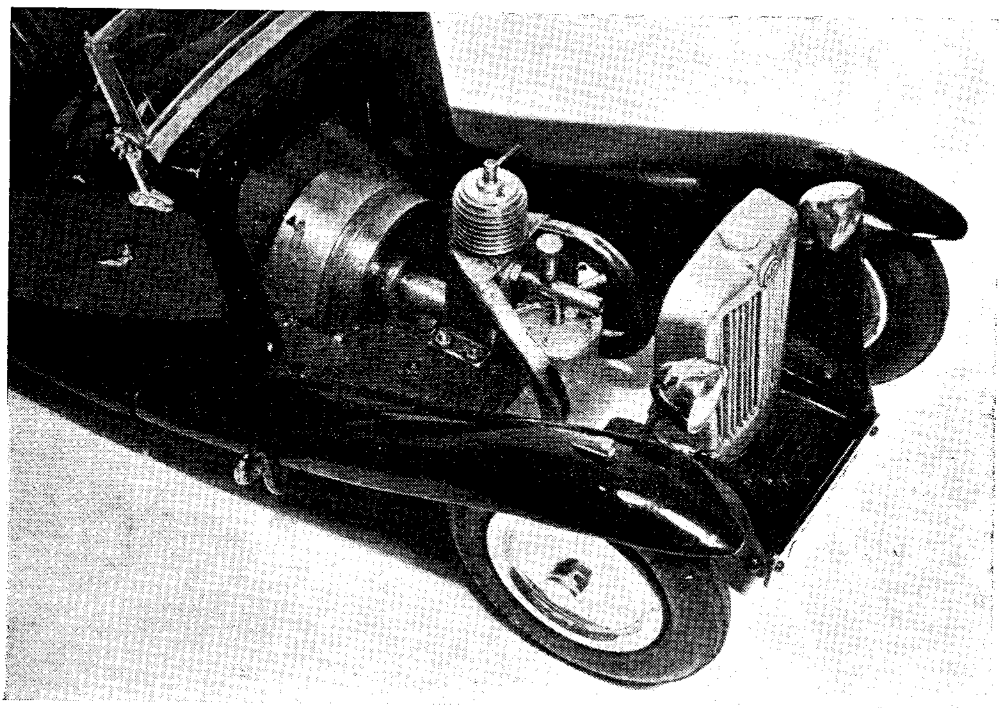
Having in my possession some miniature bulbs taken from aircraft instruments, two headlamps were turned from brass to take these lamps, Perspex fronts being shaped and fitted as lamp glasses. Two sidelamps were made from brass, filed to shape, and fitted to the mudguards by 10-B.A. screws. The two headlamps, when wired up, run off a 3-volt torch battery housed in the recess behind the seat.

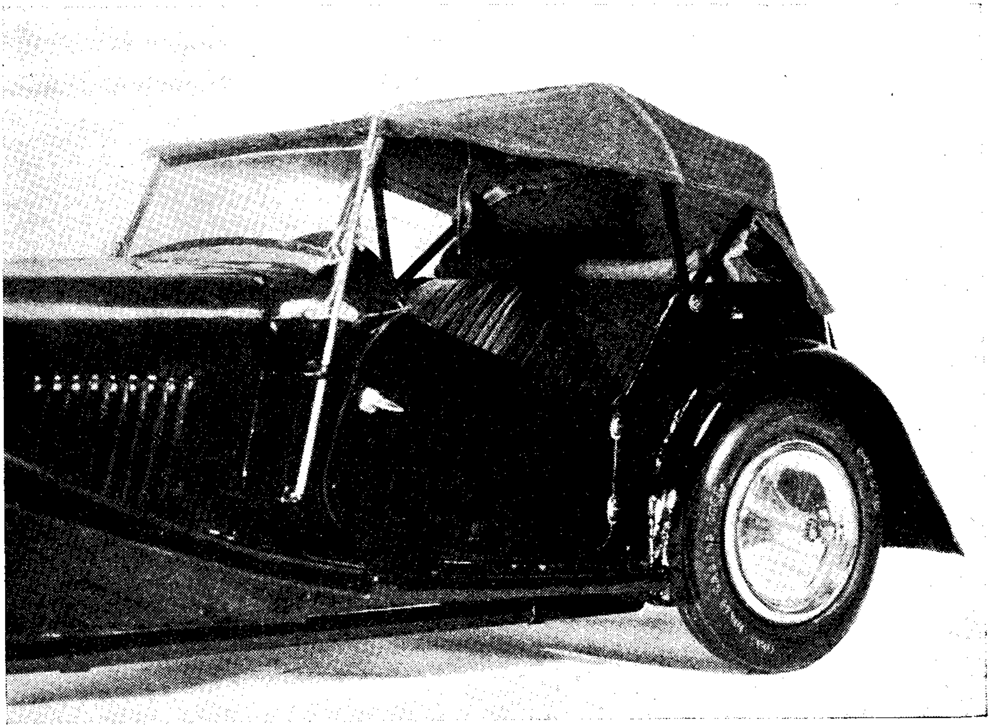


A very realistic rear view, showing the fully equipped fascia panel

The large rear petrol tank is made up from $\frac{1}{16}$-in. ply with a dummy filler cap and fastened to the body by aluminium straps. Number plates were made by using $\frac{1}{4}$-in. lead letters (as used by pattern makers) for castings and secured to $\frac{1}{16}$-in. ply number plates.

The hood, from khaki twill, was made to fold on aluminium strip stays. It folds down into the recess behind the


A neat installation of the Mills Mk. I, with exhaust pipes fitted. Note also the large clutch and flywheel and the butterfly for tightening the windscreen



This view shows the hood in the " up " position. Note the neat fitting of the door and the aerial fuel switch

seat and is covered when stowed by a khaki twill cover. In the erected position the front of the hood clips on to the two snap fastener pillars in the windscreen frame.

As the Mills engine has a built-in fuel cut-off, it was decided to use this. A car radio aerial was made and fitted to the scuttle side with an inside lever. This was connected to the fuel cut-off so that when the car is running, one can stop the motor by knocking down the aerial on its pivot.

Finally, the whole car was painted with black cellulose, the radiator silver, and all the metal parts nickel-plated. The famous M.G. radiator badge, made from ply and signwritten in the correct M.G. colours, was secured to the radiator.

Tethering attachments, made from ⅛-in. stainless-steel, were fitted to the chassis ; these go right through both chassis members and so take the centrifugal pull from each side of the chassis.

Up to date the car has not been tried out on a proper track, but prior to painting, it was tested on a school playground, using my portable anchor plate, and seemed to be running at 25-30 m.p.h. Not fast by model car standards, but most realistic in appearance. I hope to be able to test it on a proper track and so find the true speed, but provided the model laps around 30 m.p.h. with regularity and steadiness, I shall be content.

The photograph reproduced on the cover of this issue shows a three-quarter front view of the model.

THE J.I.E. DURHAM BURSARY

The Junior Institution of Engineers offers for annual competition the Durham Bursary of the value of £20 in cash. The award carries with it membership of the Institution for three years. Candidates must be over 20 and under 23 years of age at the time of entry, but they need not already be members of the Institution. They must be young men born of British parents in the British Isles, New Zealand, Australia, Canada or South Africa, and must be in course of training for the engineering or an allied profession by employment in a technical office or works, or by attendance at a recognised university, college or institute.

Entrants compete by submitting a thesis, written in English, on some engineering, technical or scientific subject selected by the entrant, such thesis being written specially for the Bursary Award. The final date for the receipt of thesis is August 1st.

Entry forms and the full conditions of the Bursary may be obtained from the Secretary, The Junior Institution of Engineers, 39, Victoria Street, London, S.W.1.

"L.B.S.C.'s" Lobby Chat

SOME of the good folk who follow these notes, say they enjoy my lobby chats, and ask why I don't include them at frequent intervals. Well, one reason is that I have been running three "serial stories" on different types of locomotives, at the same time; and as builders of these engines want to get them finished during their own lifetimes, and not leave the job for their great-grandchildren to complete, I have tried to do what the kiddies would call "keep the pot boiling." However, as the tale of the *ex*-spam-can *Pamela* has now run its course, we might snatch the chance of five minutes in the lobby; and as it will be the middle of July by the time you read this, we shan't be needing the old stove alight, and a cooling drink might be more acceptable than one out of the tea-bottle. Still, I'm no weather prophet, and you all know what British summers *can* be like, when the clerk of the weather has had one over the eight! We'll have a yarn about something wet, anyway.

Sad Tale of a Pump

Now and again I get a complaint that the pump on such-and-such a locomotive, made to my specifications, won't keep the water up. It isn't always the fault of the pump; in several instances, the valve gear and setting has been altered from the instructions given, either to suit the builder's own ideas, or on advice given by the "knowledge-box" found in every club and society. The result has been that the locomotive has needed about twice the amount of steam necessary for the job; and as you can't have extra steam without boiling extra water, the unfortunate pump couldn't stand the strain. My pumps are not designed to flood the boilers, but to be just big enough to supply a little more water than the engine should need, when working at her maximum output of power. An outsize pump will not only cause fluctuation of boiler pressure by putting in too much water at once, but it imposes needless strain on the cylinders and motion. There is considerable friction between the eccentric and strap, when the resistance of a big pump ram has to be overcome. Even if a double-acting pump with a smaller ram is used, or two separate rams operated by the same eccentric, it still takes the same amount of power to force a given quantity of water into the boiler. Any locomotive designer or builder would have to be mighty clever to fool Nature!

Sometimes, however, the fault does actually lie in the pump; not because of the design, or the size of it, but by some simple little thing like the following. A correspondent built one of the engines described in these notes, and was very well satisfied with it indeed. She steamed, pulled, and generally did the doings in the manner usually observed among efficient locomotives; more, in fact, than I claimed, as I usually underestimate on purpose. It gives the builder a thrill when his job "does better," and it tickles me no end when he writes and tells me all about it. But alas! with the by-pass valve closed, the water would gradually sink in the glass; and at $\frac{1}{8}$ in. from the bottom, the injector had to come to the rescue. One of my own engines, with a bigger boiler, has the same size of pump; and on my own road, working under similar conditions, the water gradually climbed up until it disappeared in the top nut, and if the by-pass were not opened a bit, the driver would get a shower-bath when the safety-valves lifted, or else the engine would start priming, and give the chimney liner a good wash.

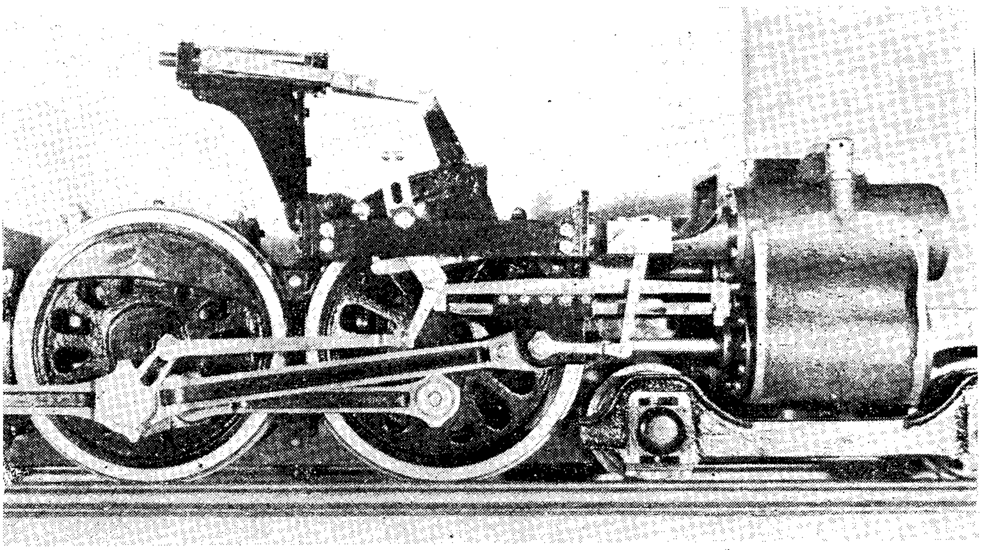
The Little Thing that Mattered

Our worthy friend assured me that the pump was exactly to specification. I knew that the engine wasn't wasting steam, by the distance she ran on one firing, and the amount of water used; so I asked to see the pump. Various folk have made injectors "exactly to specifications"—says they!—but examination has soon proved otherwise. The pump duly arrived, and was put "through the hoop." It was very nicely made, all dimensions correct, but for *just the one little thing* that made all the difference between 100 per cent. efficiency, and indifferent performance. There was just over $\frac{1}{16}$ in. lift on the suction valve ball. The suction valve was of the type I usually specify, viz. a rustless ball, seating on the faced and reamed inner end of a double union fitting. I chucked the latter in a tapped bush in the three-jaw on my Boley lathe, and took a full 1/32 in. off the shoulder with a knife tool, very slightly undercutting the shoulder, and ran a die over the threads, to ensure that the fitting would screw right home. As I keep tapped bushes of various sizes handy, the job was done in a matter of minutes, and the ball and fitting replaced.

Hey Presto!

The pump was returned, and without telling the owner what I had done, I said "try it and see if it is O.K. now." Three days afterwards, I received a letter which delightedly informed me that the water now went *up* the glass instead of down, and asking what the trouble was, as the writer could not see anything different about the pump, and jokingly said I must have practised a bit of witchcraft on it. Incidentally, he wasn't the first, by long chalks, who have suggested that I know something of the "black arts"; and thereby hangs several amusing anecdotes which maybe I'll relate one of these days. In the present instance, the explanation was very simple. As I've often had occasion to remark, everything in this benighted world takes *time*. On the outstroke, the ram sucked the ball off the seating for the full amount of its lift, until it rested against the nicks at the end of the passage-way above the seating. On the return stroke, the water had to push the ball back on the seating,

before it could lift the delivery valve ball, and go into the boiler. Now the ball in a pump valve-box doesn't fit the ball chamber like a piston fits a cylinder, and water naturally can pass the ball *in either direction*. Consequently, while the ball was returning to its seating, about half the contents of the pump barrel managed to get past it, and back into the suction pipe, before the ball finally seated home. That left only half-a-pumpful of *aqua pura* to go into the boiler at every stroke; and as it was only a small pump, the amount delivered wasn't enough to satisfy the boiler's thirst when it was working hard, so down went the level in the glass.



" *The little bit that matters* "

Whys and Wherefores

After I took the extra bit off the shoulder of the bottom fitting, it screwed into the valve-box another 1/32 in. or so, decreasing the lift of the ball to a bare 1/32 in., just sufficient to admit a full charge of water on the outstroke of the ram, at the highest speed normally attained by the engine. With this restricted lift, the ball banged down on the seating practically as soon as the ram reversed its movement, and only a few drops, at most, found their way back into the suction pipe. The rest went into the boiler, and was more than sufficient for its needs. I have tried to make this quite clear, because there seems to be still a lot of misunderstanding about pumps, especially the short-stroke eccentric-driven variety. A well-known designer, now passed on, consistently stated that they were never satisfactory; his own designs were faulty, both in clearances and valve-box arrangements. I did a lot of experimenting with pumps before arriving at the arrangement and dimensions that you now find in my various specifications. The addition of an anti-airlock pin on the end of the ram of eccentric-driven pumps, alone, made a wonderful increase in their efficiency, and eliminated any chance of air being trapped in the pump barrel. I have here, at the present minute, a pump taken off a commercially-made $2\frac{1}{2}$-in. gauge engine costing nearly £140. The pump-barrel is drilled, the end of it being conical, as left by the drill; a small hole gives communication with the valve-box. The ram is square-ended, and has a clearance of a full $\frac{1}{16}$ in. between the end of it and the cone left by the drill. It is impossible to get rid of the air trapped in this big space, and the air is compressed as the ram moves inward, expanding again as the ram moves outward. The valve lift is also excessive, and the net result is that the pump only delivers a few feeble drops of water at each stroke. It was just absolutely useless on the engine to which it was fitted. I keep it as a shining example of how *not* to do it! Incidentally, I gave the boiler off the above-mentioned engine to a friend in Scotland. It went all around the various clubs, and paid a visit to the boiler shop at Cowlairs Works, where the twenty-seven $\frac{1}{4}$-in. tubes, with a bore of about $\frac{3}{16}$ in., and the huge flap door and ridiculous fittings, provoked much hilarity. It was eventually cut up, and the barrel, and some of the copper, used to make a *Juliet* boiler.

Returning to the subject of valve lift in a pump, the lift of the delivery valve is not of such great importance as the lift of the suction valve, although it should not, of course, be allowed an excess of movement. The difference is, that whilst on the outward stroke of the ram, the suction valve has a partial vacuum above it, and will move up as high as it possibly can, the delivery valve always has the boiler pressure above it, even with a top clack (as the enginemen call it) between it and the boiler. Consequently, the delivery valve will not rise any higher than is absolutely necessary to allow the water forced

by the ram on its instroke, to pass. As soon as the ram finishes its forcing stroke and reverses its movement, the delivery valve seats immediately with great alacrity. Beginners should be interested in the above explanation, for in a recent letter, one of them told me that Mr. I. Knowitall, of Soandso S.M.E., had tried to impress on him that my pump design was all wrong, inasmuch as the valves should have plenty of lift, to allow free passage for the water. Well, well—"where ignorance is bliss"—you know the rest!

"Hot" Controversy

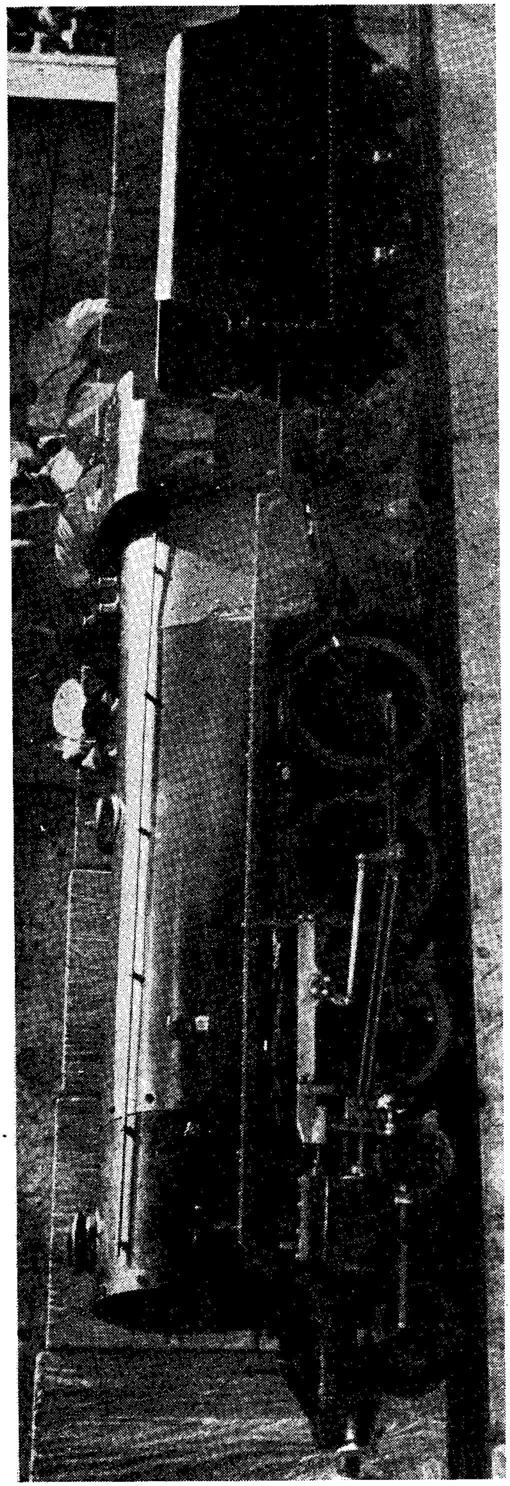
Your humble servant noted with some interest, the recent editorial about high boiler pressure and superheat, and also comments on same. Now I have done quite a lot of experimenting in this direction also—to quote a well-known daily paper, "It's fun finding out"—as I actually build and run locomotives, and do not depend either on theories, or the experiments of others. There is a definite relationship between boiler pressure and superheat temperature; and correct combination will produce remarkable results. To explain briefly, let us imagine two locomotives, one with a boiler carrying 120 lb. pressure and having one or two superheater flues and elements; the other carrying 80 lb. pressure and having four or six superheater elements. One would naturally think that the high-pressure engine would be better, as the steam would be forced into the cylinders more quickly, and could be cut off earlier than in the lower-pressure engine; but such would not necessarily be the case. The higher the temperature of the steam, the greater its "fluidity," as our scientific friends would put it; in other words, the more heat you put into the steam, the more lively it becomes. The hotter steam of the lower-pressure engine would slip into the cylinders just as quickly, and could be cut off just as early, its added liveliness and elasticity doing all that was necessary in the expansion line. The engine carrying the higher pressure would presumably be provided with fairly small-bore cylinders, in order that the tractive effort would not be too much for the available adhesive weight; but the lower-pressure engine would have the size of cylinder that I usually specify. I guess I've tried about every possible combination during the years that I have spent in locomotive building and sundry experimenting; and with an efficient superheater providing really hot steam, cylinders of "scale" bore, or maybe in some cases a little larger, will give the best results at moderate boiler pressure. My 3½-in. gauge Webb compound is a good example, having "scale" cylinders, both high and low pressure, and the working pressure of the boiler is 90 lb. per sq. in., the steam being well superheated.

Readers who have built locomotives described in these notes, have noticed that although the exhaust pressure is low, they get sharp clear beats, and a good pull on the fire. This is due to the arrangement of ports, valve-gear, and setting. It isn't the *amount* of steam, but the speed at which it leaves the blast nozzle and shoots up the chimney, that produces the effects stated. I thought that with the double expansion of a compound engine, a high boiler pressure would be needed, to get enough draught at the final exhaust; but such was not the case. At the equivalent load and speed of 320 tons at 90 m.p.h. notched up to 25 per cent. cut off, the exhaust from the high-pressure cylinders is down to 10/12 lb. only; and by the time that has been through the low-pressure cylinder, it is reduced to little more than atmospheric pressure. Also there are only two beats per revolution, to maintain the draught on the fire; yet the safety-valves will blow like nobody's business if the firehole door is kept closed! The secret is just hot steam. After leaving the high-pressure cylinders, the exhaust steam passes through another superheater element, and is reheated to an extent that gives it sufficient energy, not only to give the huge L.P. piston a mighty "kick in the pants," but to shoot out of the blast nozzle (which is nearly as big as the pipe) with sufficient speed to keep the fire merry and bright. Only a very thin fire is needed; too thick a fire would simply choke the engine altogether.

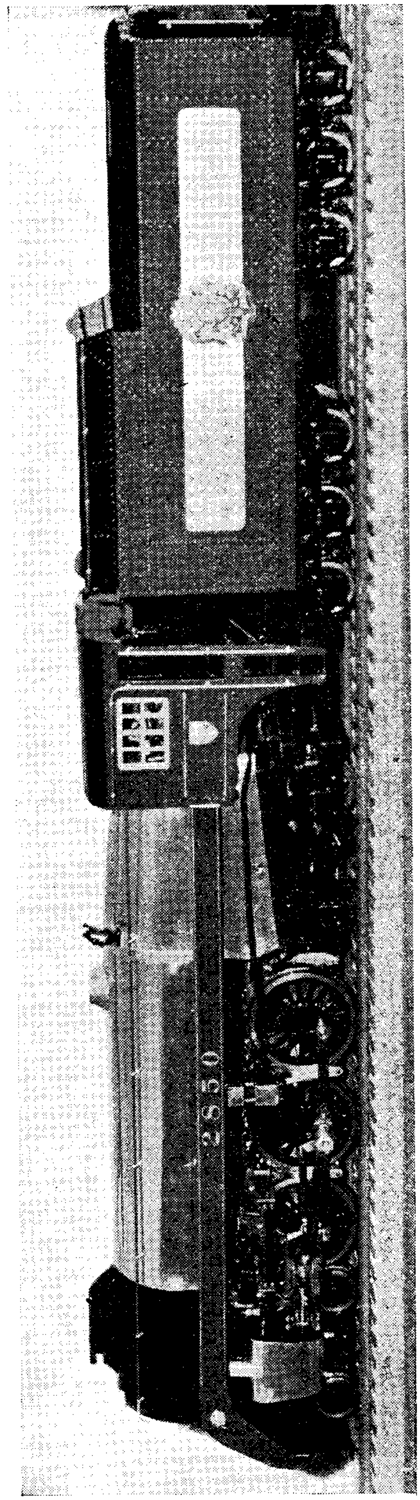
Many years ago, when I built my 2½-in. gauge four-cylinder eight-beat *Caterpillar* 4-12-2, as an experiment I made the boiler strong enough to stand a working pressure of 175 lb. if necessary. You can hardly see the firebox sheets for stay-heads! I soon found that this pressure would never be needed, because at a Model Railway Club Exhibition, some 25 years ago, she took her turn on the passenger-carrying track with engines twice her size, and with 90 lb. "on the clock" (the safety-valves were set for that pressure) she had no difficulty in hauling ten adults at a time. The cylinder power was ample at that pressure. Incidentally, the old girl is still as lively as ever; on the evening of June 9th she took me just over two miles non-stop on three-parts of a tenderful of water, at a steady "mile-a-minute" clip, the weeny driving wheels spinning like buzz-saws, with just a faint purr at the exhaust, and a dull red fire. The safety-valves were lifting at 75 lb. as the springs have become weak.

Talking about long runs, it always amuses your humble servant when anybody says that their engine will run for an hour or so on one firing, with the wheels jacked up. Bless your hearts and souls, my old tin toy *Ajax* of childhood days did that! On dark winter nights, or when the weather was bad, I used to fill the boiler and lamp, put the engine on the kitchen table, with the back end propped up just enough to let the wheels spin, get up steam, and let her run "light." She would keep going for well over an hour.

Anyway, to cut the story short, my own experience is that a high boiler pressure is not necessary; a moderate pressure, with high superheat and ample cylinder capacity, will do all that is necessary, in the most economical way. There is no need to build 150 lb. boilers, except for the sake of experiment, when the lower-pressure boilers are both easier and cheaper to build. Also, the high-pressure boiler is more difficult to keep, "on the pin"; and if the pressure drops much, the engine is soon completely whacked, as the piston area is insufficient for the reduced pressure. The lower-pressure engine with big cylinders is far more stable; if the



Mr. John Hewitson's converted "Royal Scot"



Mr. Hewitson's C.P.R. 4-6-4

pressure should fall, due to bad coal, or poor "firemanship," she will still "keep on keeping on," as the piston area will still be sufficient to give the power needed. As long as the lubrication is above suspicion, you can't have the steam too hot, within reason.

An Interesting Conversion

In a friendly and cheerful letter from Montreal, Mr. John Hewitson tells of the alteration of a $3\frac{1}{2}$-in. gauge 4-6-0 *Royal Scot* into a Pacific. In its original condition, the engine was very unsatisfactory, so he made and fitted a new pair of slide-valve cylinders, as per my usual specifications, and added a mechanical lubricator, trailing pony truck, and a new wide-firebox boiler. These alterations made a wonderful difference, the engine now being a fast steamer and remarkably free running. It has attained a speed of 12 m.p.h. on the Red River Valley line at Mr. Hewitson's home town of Winnipeg, where he served his apprenticeship on the C.P.R.

Our worthy friend has also completed a 4-6-4, and has a 4-8-4 under way. The former engine, shown in one of the photographs, has cylinders $1\frac{3}{8}$ in. × $1\frac{7}{8}$ in., with $\frac{13}{16}$ in. piston valves, the bobbins having rings. There is no sign of blow-by after 12 years' service. The coupled wheels are $4\frac{11}{16}$ in. diameter. The boiler, which carries 90 lb. pressure, has a feedwater heater; but neither this nor the conversion engine, has any superheater. Our friend says he was advised not to use superheated steam by certain club members—Messrs. Knowitall & Co. again!—but he knows better now, and the 4-8-4 will be well hotted up. The latter is a three-cylinder job, same size cylinders as above, so she ought to be able to shift something. The boiler, now under construction, also has a feedwater heater, and will be fed by a twin eccentric-driven pump, and two injectors of different sizes. Mr. Hewitson pays a kindly tribute to my injector instructions, saying that he made one up, to specifications, with a delivery cone drilled 0.022 in. (No. 74 drill) and it fed a small vertical boiler only $3\frac{1}{2}$ in. diameter, without knocking the pressure down, and without losing any water at the overflow. Hearty congratulations to our friend on his nice work, and good luck to the 4-8-4.

Quartering Locomotive Wheels

IT has been with interest that I have read in THE MODEL ENGINEER during the past few years of the various procedures advocated by contributors of quartering the wheels of model locomotives. Most of the methods which have been described appear to rely on an element of chance or to necessitate the production of some special jig or fixture, and I think the method which I adopted to quarter the coupled wheels of the $3\frac{1}{2}$-in. gauge "Pamela" which I am building may be of interest to readers.

The wheels, axles and crankpins are machined by the usual method, centre holes being drilled in the axles if these are machined in a three-jaw chuck or collet, and the wheels being a push-fit on the wheel seats for about $\frac{1}{8}$ in. Crankpins are then pressed in and one wheel pressed "home" on to each axle, the other being pushed on as far as possible by hand. With the faceplate mounted on the lathe and the mandrel locked in position, the assembled wheels and axles are mounted between centres, the headstock centre engaging in the centre of the axle and the tailstock centre in the reamed hole of the wheel.

One piece of scrap rectangular bar stock of any convenient size is clamped to the faceplate with one edge vertical and directly above (or below) the lathe centre, and another piece of bar is mounted in the toolpost so that the top face is at centre height. The wheels and axle are rotated until the crankpin comes into contact with the block on the faceplate and the other wheel then rotated on the axle until its crankpin contacts the bar held in the toolpost. This wheel is then pressed a little farther on to the axle by means of a press or vice, remounted in the lathe and checked with feelers. If a 0.001 in. feeler will not pass between either crankpin or block, then the setting is correct and the wheel may be pressed home.

This procedure is repeated with the remaining wheels and axles, no adjustment being necessary when the crankpins are of different sizes, as the wheel on each end of the axle is thrown back an identical amount.

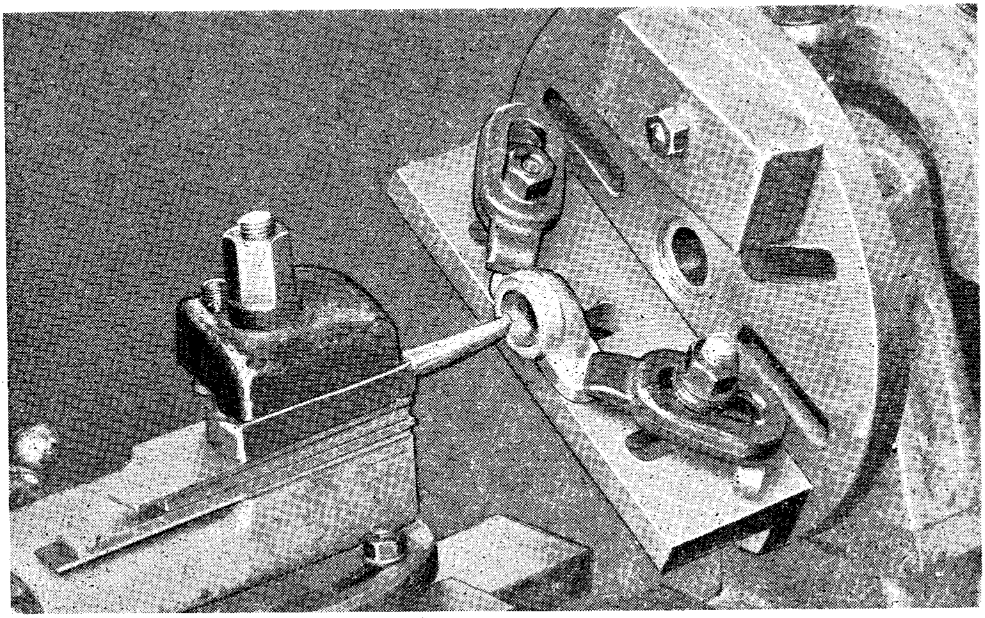
It will be seen that no elaborate equipment is needed, no special jigs, etc., need to be made and accuracy is assured, provided that the mandrel is securely locked in position, the toolholder is not moved during setting and that the crankpins are brought to the blocks in the same direction, i.e. assuming that the crankpin at the tailstock end is brought down on top of the bar in the toolpost, then the crankpin at the headstock end must be brought against the block on the faceplate in an anti-clockwise direction when looking towards the faceplate, whether this block be above or below the centre depending on whether the left-hand or right-hand crankpin is to lead.—P. J. DAFFURN.

PETROL ENGINE TOPICS

*A 50-c.c. Auxiliary Engine

by Edgar T. Westbury

AFTER the completion of the major components, as described in foregoing articles, it is necessary to consider final details of installation, and accessory fittings. The latter include the exhaust and inlet pipes, carburettor and magneto. With regard to the pipe fittings, a good deal will depend on the position of the engine when installed ; it has already been pointed out that it is adaptable to various positions, including vertical, horizontal, or inverted, and readers may have their own individual views and preferences in these matters.



Exhaust elbow set up on angle-plate for boring and screwcutting

The engine will work quite well in either position, but there is a slight objection to inverted fitting, as the sparking plug is then in such a position that it collects any oil which drains down the cylinder walls while standing, or liquid fuel which is liable to accumulate through excessive flooding or choking when starting from cold. I have found, generally speaking, that if the engine can be relied upon to start instantly, (as all well-trained engines should !) there is no objection to the inverted cylinder, but if for any reason it does not do so, the natural thing for the operator to do is to " give it plenty of choke " to use a common but incongruous expression ; and that is where the trouble is liable to start.

However, the tests of the engines which have so far been built have been mostly carried out with the cylinder horizontal, and as this position has also been found very convenient for installation, the fittings have been designed to suit this position. Readers who wish to modify the installation arrangements will no doubt find it quite a simple matter to alter the fittings as required.

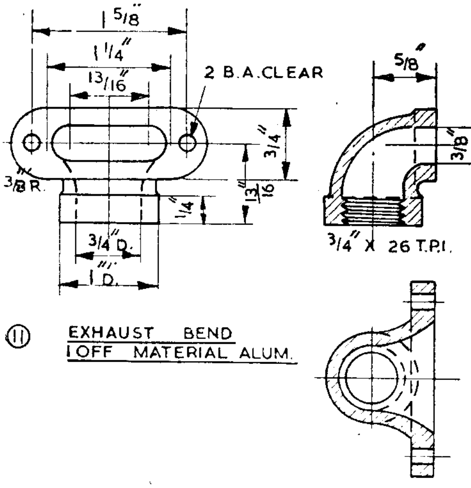
Exhaust Elbow

This is arranged to suit a special silencer designed for this engine, which will be described later. Although it is not, generally speaking, desirable to introduce sharp bends into the exhaust pipe, it has been found that no undue back pressure is set up if the bend is kept as smooth as possible and the cross-sectional area of the passage is adequate. A casting is available for this component, and machining is quite simple and straightforward.

The casting is first set up in the four-jaw

*Continued from page 8, " M.E.," July 5, 1951.

chuck for machining the joint face; it may be found that there is a tendency for it to tilt in the chuck jaws, and the best way to avoid this is to hold it by three jaws only, two gripping the sides, immediately above the circular collar, and the third brought up against the underside,



with a flat packing-piece interposed, just sufficiently tightly to prevent it from tilting. It is, of course, unnecessary to centre the joint flange, but it should be as true as possible on the face, in both planes, and only one or two light cuts are necessary to produce a smooth flat surface.

It is then mounted on an angle-plate for facing, boring and screwcutting the outlet end, as shown in the photograph. Two clamps bearing on the lugs of the flange are used in this instance, but in some cases it may be found more convenient to drill the holes in the flange and use these to take bolts for clamping it to the angle-plate.

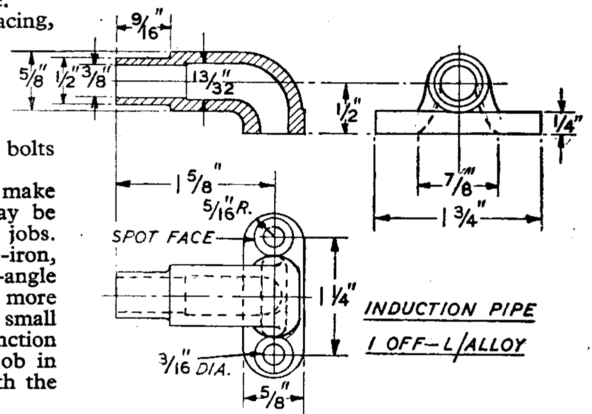
Incidentally, I may mention that I often make use of improvised angle-plates, which may be mounted on a small driver-plate, for light jobs. These are made from odd bits of angle-iron, which are filed or machined to a true right-angle (this is *most* important) and are often much more convenient than a heavy angle-plate for small finicky jobs; moreover, one has no compunction about drilling holes in them to suit the job in hand, which never seems to match up with the holes in a standard angle-plate.

The casting must obviously be set to run truly on the circular boss face, and it can then be machined as required, including internal screw-cutting to a convenient fine thread, the pitch specified being standard brass pipe thread, which is most suitable for attaching light gauge pipe. This thread goes in about ¼ in., beyond which the cored passage is relieved to form a clearance, but it may be found that owing to difficulty in ensuring accuracy in locating the core, the passage is slightly eccentric, and a little judicious work in clearing it out may be desirable. In any case, it is a good idea to use a rotary file or riffler to clean out the passage and make it as smooth as possible.

The carburettor recommended for this engine is the Amal type 308, which is a very light and compact miniature edition of the type employed on many lightweight motor-cycles, adapted to the requirements of the 50 c.c. class of engines. This is made with a split clamp fitting to suit an inlet stub ½ in. diameter, having a maximum permissible bore of ⅜ in., so that these dimensions govern the size of the induction pipe itself. As the fitting was not definitely finalised at the time the patterns were made for the engine, no castings for the induction pipe are as yet available, but this deficiency will be rectified as soon as possible.

To machine the joint face of this casting, the best way is to clamp the straight part of the pipe in a small vee-block (a temporary one for this job can be made up in a short time) and mount this either on the faceplate or in the four-jaw chuck, so as to hold the flange square with the lathe axis in both planes, but with no regard to concentric running. After this face is machined, it can be set up on the angle-plate in the same way as the exhaust elbow for machining the inlet end. As the wall thickness at this end is only 1/16 in., and cannot be increased without encroaching on the area of the bore, the cored hole must be set to run as true as possible, and should be cleaned out with a boring tool and finally finished with a reamer or D-bit. In this case also, cleaning of the cored passage with a riffler or rotary file is highly desirable, to avoid any possible restriction of the gas flow.

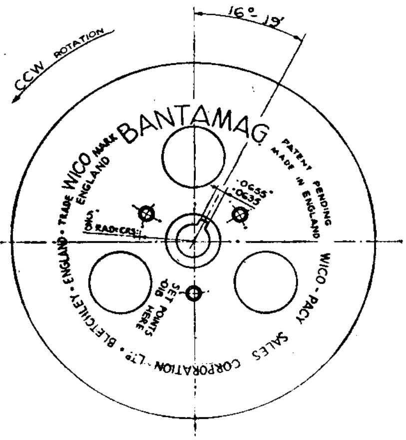
The fixing holes in the flange of the induction pipe, and also that of the exhaust elbow, should be spot-faced to form a true seating for the fixing nuts.



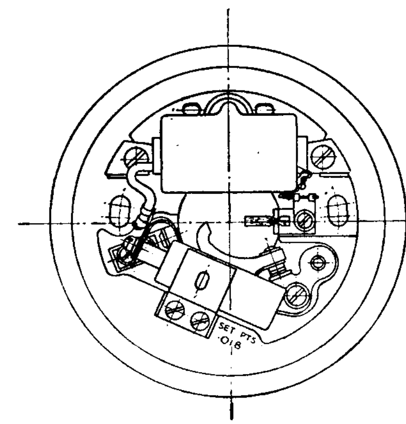
Magneto Fitting

It has already been stated that the Wico "Bantamag," which incidentally is the smallest commercially produced flywheel magneto available, is recommended for this engine, and has been successfully applied to the engines which have so far been built. At the time when these were first fitted, no definite particulars had been obtained from the makers as to method of timing, etc., and it was therefore impossible to specify, on the drawings of the crankshaft, the exact taper dimensions, or the position of the keyway for the flywheel and contact breaker cam, but these details have now been obtained, and are given herewith.

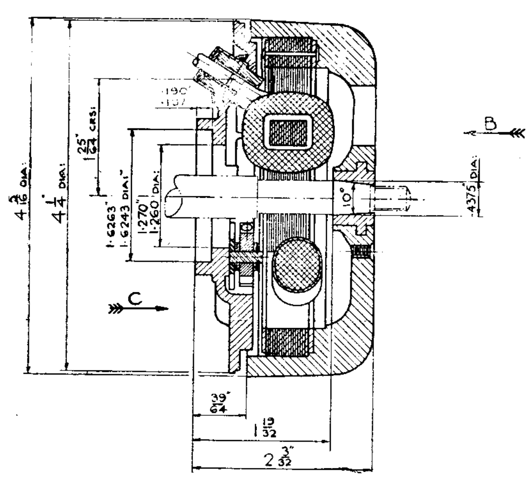
The "Bantamag" magneto, on account of its small size, and consequent lack of space in the centre of the assembly, does not have the contact-breaker cam integral with the flywheel hub, as is usual in larger magnetos of this type. Two possible methods of operating the contact-breaker are recommended, one being by the use namely, the position of the flywheel (to which the magnet system is positively attached) relative to the point at which the contacts break, and the timing of the break relative to the engine cycle. These two entirely separate but inter-related factors may prove confusing to some constructors, especially as they are affected by the direction



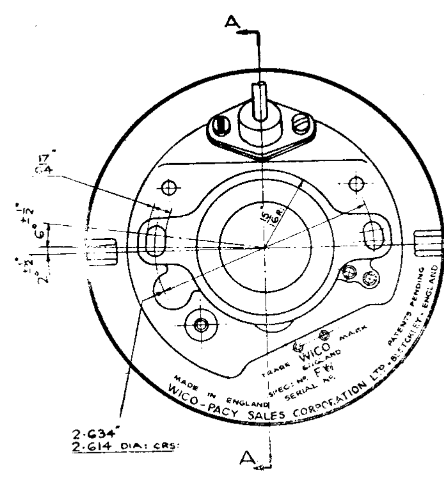
Front view of "Bantamag" flywheel, showing position of keyway at the instant of break



"Bantamag" backplate, showing stationary electrical system



Longitudinal section through "Bantamag" magneto



Rear view of "Bantamag" backplate

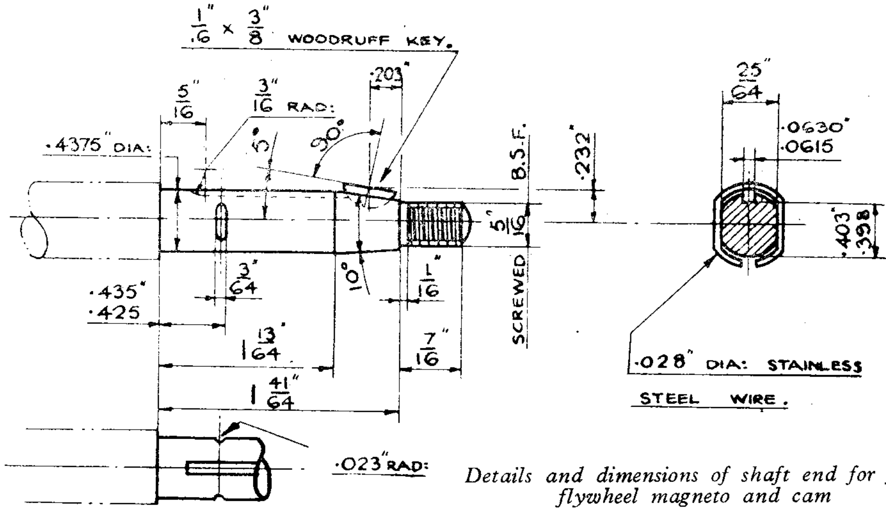
of a separate cam keyed to the crankshaft, and the other by cutting a cam on the mainshaft itself. In either case, the relative positions of the cam and the rotary magnet system are of the greatest importance, (apart from the timing relative to the crank angle or piston stroke) as the cam must operate to break the circuit at the instant the current flow in the primary winding reaches its maximum. In fitting the magneto, therefore, two essential factors must be considered in conjunction with each other, of engine rotation, so the instructions for timing (from information furnished by the makers) are given below, and should be carefully studied.

First of all, it is noted that the "Busy Bee" engine, when fitted for driving a cycle by friction roller, with the cylinder horizontal, and on the near side (left-hand, looking from the rear end), must run in an anti-clockwise direction, at the flywheel end. The drawing shows the outside of the flywheel, indicating the angular position of the keyway *at the instant of break.* This

means to say that if the engine were timed to fire exactly at top dead centre, the key in the crankshaft should be fitted at such an angle so that the flywheel is in this position with the piston at T.D.C., assuming also that the backplate is fitted so that the high tension terminal is at the top, as in the views of the front and back of the backplate.

piston exactly at the top dead centre.

The best position for the high-tension terminal, when the engine is horizontal, is at the top; that is, at right-angles to the axis of the cylinder. Therefore, the angle of the keyway in the shaft relative to the crankpin, should be (90 deg. + 25 deg. + 16 deg. 19 min.) = 131 deg. 19 min. in an anti-clockwise direction. It should, however, be noted that the backplate may be set in any position round the clock, according to the position of the fixing screws, so long as this is allowed for in the timing of the keyway; and this may be found useful if an error should occur in the latter respect, but it does not allow compensation for errors in the relation of the cam with the flywheel.



Details and dimensions of shaft end for fitting flywheel magneto and cam

But as the spark must be timed in advance of the top dead centre, for efficient running of the engine at its normal working speed, any angular advance must be superimposed on the angle shown. So far as running control is concerned, the ignition timing of these magnetos is fixed, though about 6 deg. of pre-adjustment can be obtained by the slots in the magneto backplate which take the fixing screws. Personally, I think that running control of spark timing would be a great advantage, but it would be difficult to obtain without considerable complication of these small magnetos, which can only be sold at their present low price by keeping them to their simplest essentials. If, however, constructors care to go to the trouble of devising a means of shifting the backplate by means of a control lever, it is by no means impossible to obtain this extra facility. Such movement would not in any way affect the essential relationship between the timing of break and the position of the rotary magnet (which determines optimum spark efficiency), but only the actual timing of the spark relative to the crank or piston of the engine.

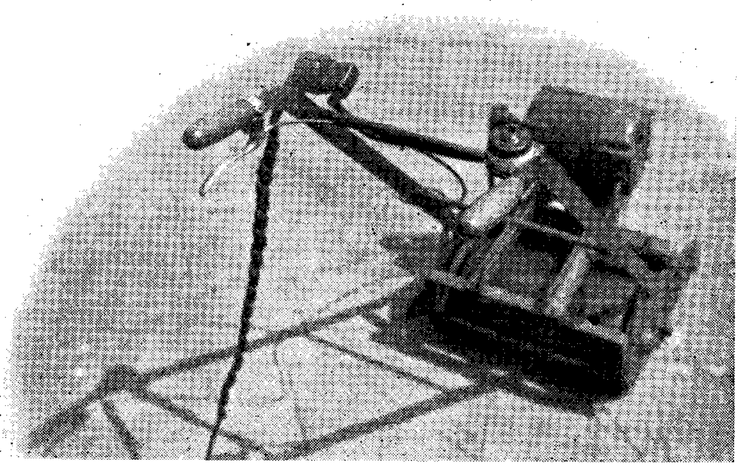
A good many experiments have been made to find the best all-round timing for "fixed" ignition on an engine of this type for normal road work, and it has been found that about 25 deg. advance gives good results in cases where no very steep gradients are encountered, but in very hilly country it may be found desirable to retard the ignition to 20 deg., or less, before T.D.C. The actual timing of the keyway, therefore, should be at the specified angle of 16 deg. 19 min., *plus* the angle of advance, with the piston exactly at the top dead centre.

The cam is bored to fit a shaft diameter of $\frac{7}{16}$ in. and is located by a small pressed-in tongue of metal which serves the purpose of a key, as the driving torque is very light. Endwise movement of the cam is prevented by a small wire circlip which engages two slots machined or filed in the shaft. Should constructors wish to machine the cam on the shaft itself, it should be noted that the diameter of the shaft at this point is less than that specified for the cam circle, but I have found the latitude of contact-breaker adjustment enables it to work with a cam cut on an $\frac{1}{2}$ in. diameter shaft. The fitting of a larger diameter ball-race at the magneto end, however, (there is plenty of room for it in the housing) would permit of making the cam to the correct specified size. I do not propose to give exact details of the cam contour here, but they can be supplied if the demand arises.

Note that the greatest care must be taken to mate the taper of the shaft to that of the flywheel. Don't condone any errors in this respect by the thought that the key will hold it, whether the taper is right or not; I can assure you, from actual evidence of sheared keys, that it will not do so, however tightly the shaft nut is screwed up.

(*To be continued*)

MOWING WITHOUT BLOWING!



by

D. C. MORTON

THAT is my experience in cutting lawns with my motorised Qualcast lawn mower. And using well-known statistics, there is no reason why 3,000,000 more should not say the same!

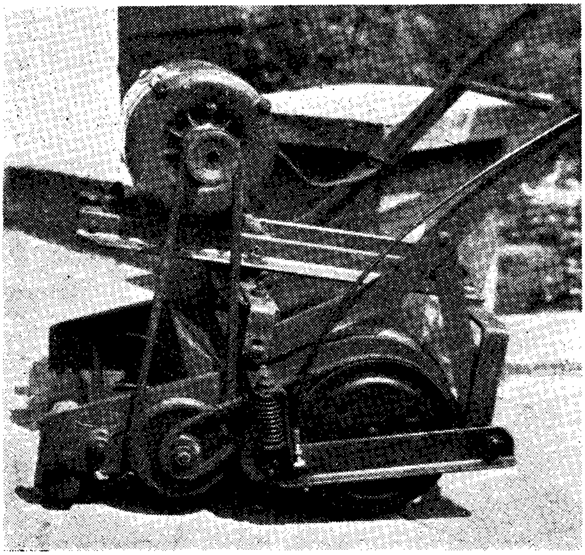
In adding a motor to the machine (actually a ¼ h.p. Brook Cub was used), the dead weight to be pushed is severely increased, so the power from the motor was naturally harnessed to propel its own weight, and, of course, the machine as well—and, incidentally, as an experiment, the writer on more than one occasion!

The controls are simple. On one handle is mounted a switch which operates the motor, and a bicycle brake lever combines with the other handle to operate through a Bowden cable, a very cheap, but none the less effective clutch.

The motor is mounted on an angle structure which pivots about the rear stay-rod. Its elevation is controlled by ⅜-in. Whit. screws fixed to a crossbar pivoted on the top centre stay. These screws are of such a length as to provide adequate adjustment for the belt which drives the cutters.

To facilitate manoeuvrability of the mower, it is important to place the motor as far over the rear roller as the mower frame will allow. A 2 in. P.C.D. ½-in. V-pulley is fitted to the motor shaft and the position of the motor in plan, in relation to the side frames, is governed by the alignment of the cutter drive.

The original chain is dispensed with, and the sprocket on the cutter shaft is also not required. A standard 4 in. P.C.D. ½-in. V-pulley has a 1⅝ in. P.C.D. V-groove machined on its boss. This pulley is then fixed to the cutter shaft, a grub-screw tightening up on the existing flat on the shaft. The large diameter end face of the pulley fits next to the side frame.



For the drive to the rear roller, a 6 in. diameter ½-in. V-pulley is attached to the existing chain wheel with three ⅜-in. Whit. nuts and bolts. A vee-belt is chosen a little too long, so that a jockey pulley is required. This jockey pulley is, in fact, the clutch, and in this case, was made of brass about 2 in. diameter with flanged ends. The pulley runs loosely on a pivot bolt attached to the end of an arm, itself pivoted to the rear stay-rod.

A motor-car valve spring normally keeps the lever depressed down, so that the belt is slack and the machine stationary, although the cutter, of course, may be revolving. The Bowden cable is arranged to lift the jockey arm up against the pressure of the spring, and cause the belt to wrap further round the small pulley on the cutter shaft, and take up the drive.

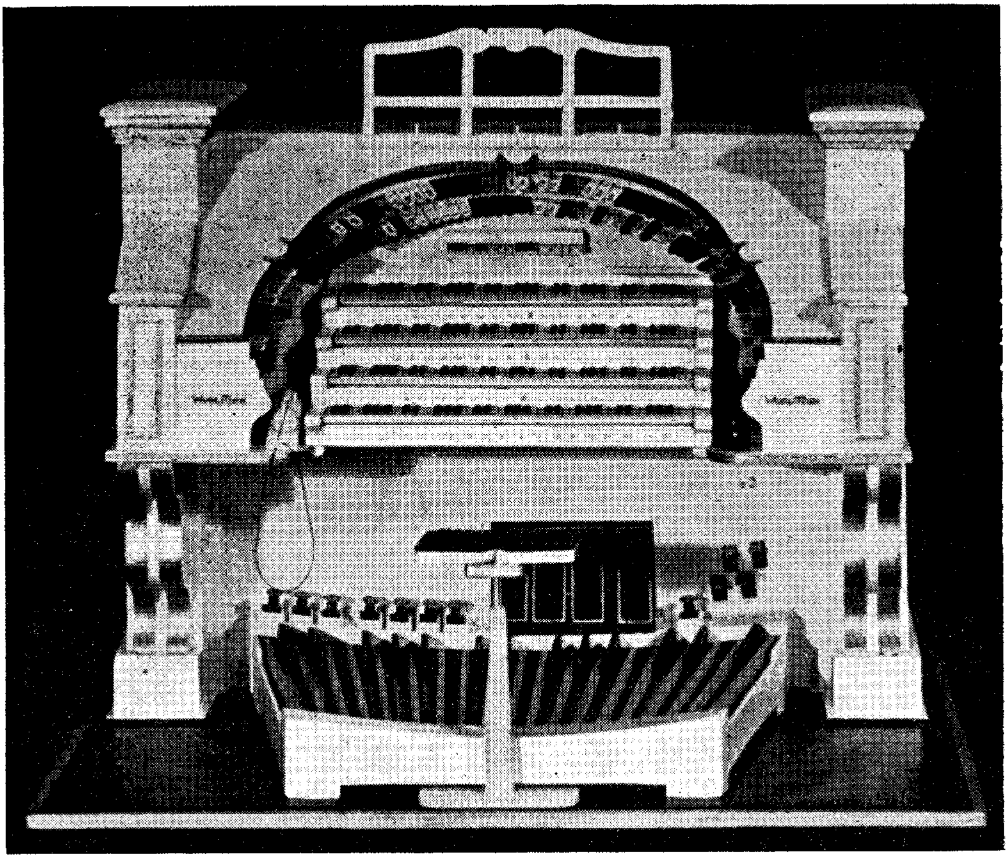
The diameters of the drive pulleys chosen provide a maximum "lawn speed" of approximately 3 m.p.h., which has been found to be very satisfactory. By slipping the clutch, lower

(*Continued on page* 85)

*A Model Organ Console

by M. G. Brewer

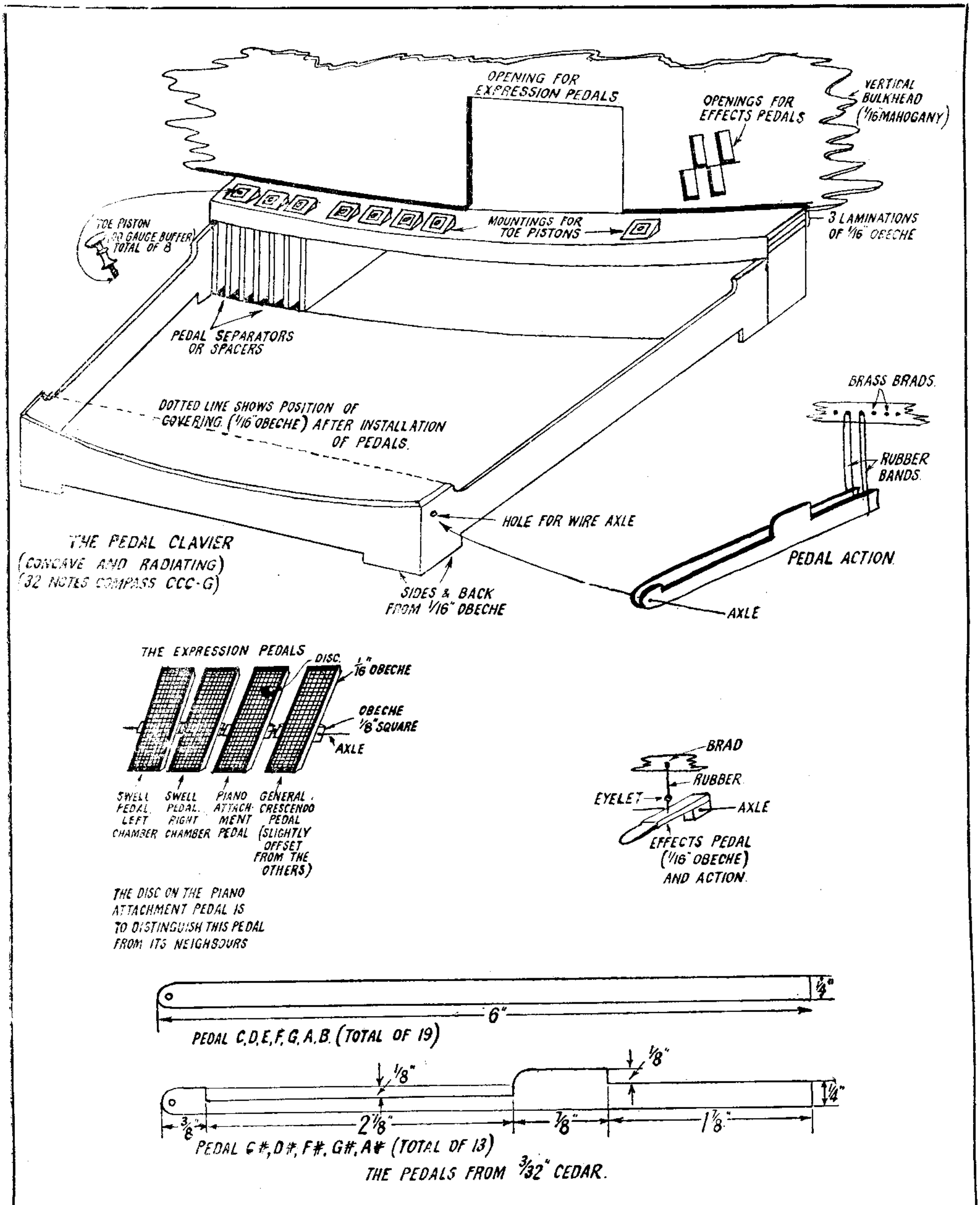
THIRTY-TWO small brass brads were arranged in a row on a piece of obeche and fitted to the inside of the console, above the forward end of the pedals. The rubber bands were then looped on the brads. This pulled the pedals up against the curved portion at the front which was later painted silver to give the impression of angle aluminium or steel. A piece of obeche, $\frac{1}{8}$ in. square, was then bored down the centre of its length and glued to the back of the pedals at about a third of the distance up each pedal. (This piece of obeche was $2\frac{1}{4}$ in. long.)



of the pedal board and imparted a very nice concave effect. I now had a most realistic pedal board with pedals which would depress and, when released, spring back into position. The rubber bands immediately behind the expression pedal opening in the bulkhead were then removed to allow the installation of the four expression pedals. These were made of $\frac{1}{16}$-in. obeche and measure $1\frac{1}{4}$ in. $\times$ $\frac{3}{8}$ in. An imitation tread was effected by scoring the wood first up and then across each pedal. They were then "edged" with paper Each one was then separated and all four were mounted on a wire axle. The complete set was then fitted into place behind the bulkhead, so that the pedals projected slightly through the aperture cut for them. The four effects pedals were made from $\frac{1}{16}$-in. obeche and installed in a similar manner to the pedals of the pedal clavier. The rubber bands taken from the pedals of the pedal clavier to allow this work to be done were then replaced, and the back centre panel was slipped into place.

I was at a loss to know what to use for the toe pistons at the front of the pedal board. It was then that I thought about "OO" gauge railway

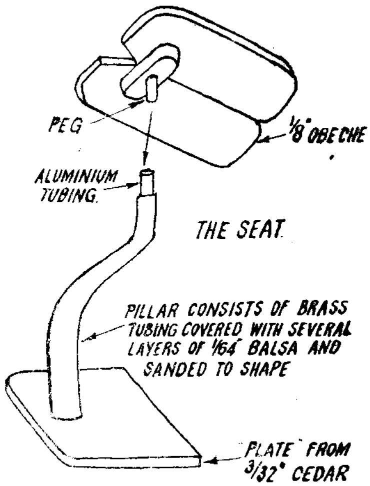
*Continued from page 38, "M.E.," July 12, 1951.



buffers. These suited my purpose very well and I had hoped to fit the sprung type to simulate working toe pistons, but then I realised that the shanks would interfere with the action of the pedal clavier. So I decided to use the ordinary type and cut the shanks down to about the fifth thread of the screw. The buffers were mounted on small squares of obeche and fitted in position, sloping slightly towards the rear of the pedal board. The lower part of the console was now complete and attention was devoted to the upper part once more, and the building of the manuals began.

The bottom of the manual bed was cut to size from $\frac{1}{16}$-in. sheet mahogany. The sides were made from $\frac{1}{8}$-in. obeche and filed and sanded to shape, the ends of the steps being rounded. The key slips were then cut from $\frac{1}{16}$-in. mahogany

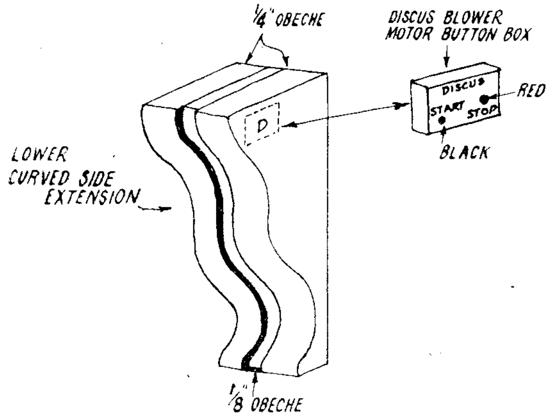
and the holes for the thumb pistons were bored with the aid of a pin-chuck and a small drill. The thumb pistons are pinheads, cut so that just enough of the pin fitted into the key slip to make it secure when glued. The pistons were arranged in two groups of six beneath each manual as can be seen by reference to the photograph. Each manual consists of a piece of $\frac{1}{16}$-in. mahogany which was covered with two layers of good quality



white glazed paper firmly glued on. Then a layer of thick white card was glued on each, this card slightly overhanging the edge. The final layer of thin card was now added, again slightly overhanging. The effect of separate keys was obtained by making 35 parallel cuts across each manual, each cut being taken right through the top layer. This gave 36 white keys per manual which represents a compass of five octaves (CC-C). The sharps or flats (black notes) were then glued on, care being taken to preserve a straight line

The console lift button box was made from a piece of $\frac{1}{4}$ in. × $\frac{5}{16}$ in. obeche, sloped and with pinheads to represent the "up," "stop" and "down" push-buttons. The printing on the box was done in white ink and it was mounted to the right of the lowest manual.

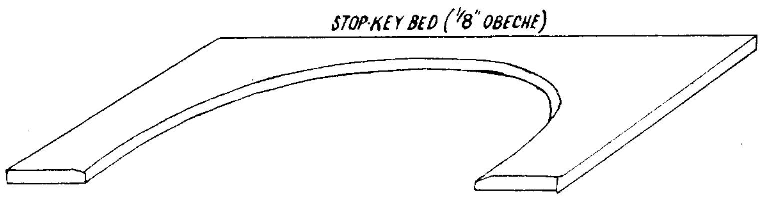
The telephone was purchased from Woolworth's, but the handset rest was too large to fit in the space intended for it, so I made another



from scrap wood. The telephone "wire" is a piece of thread.

The discus blower motor button box was made in the same way as the lift button box with two pinheads for the "start" and "stop" buttons. This was glued to the inner side of the left curved side extension just beneath the "table."

A piece of circular waste from an ordinary office punch was used for the action current voltmeter. This was suitably inscribed with indian ink markings and glued to the inner side



along each manual. They were trimmed and sanded to correct shape. Each manual was then fitted into position in the bed. The top manual slopes towards the front of the console, the third slopes slightly less, whilst the lower two are flat. The complete unit was then glued into position in the console.

The short row of stop-keys (second touches and tremulants) between the top manual and lower row of stop-keys was then made up and fitted. These stop-keys are similar in shape to those in the two main rows, but are slightly smaller. There are 13 in all.

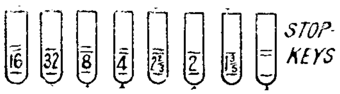
wall just to the right of and above the lift button box.

The tops of the sides were made from several laminations of $\frac{1}{8}$-in. sheet obeche, each lamination being slightly smaller than the one above. The top one was bevelled at the edges.

Obeche, $\frac{1}{8}$ in. × $\frac{1}{16}$ in., was used for the music stand, halving joints being made at the points where the spars cross for extra strength, and is detachable for easy transport of the model.

The seat pillar consists of a piece of brass tubing covered with a number of layers of 1/64 in. balsa liberally coated with glue. When the glue

had dried hard the pillar was brought into shape with a piece of fine sandpaper. A small piece of aluminium tubing was then fitted to the top. The seat itself is of $\frac{1}{8}$-in. obeche and a peg was fitted to the underside. The peg slips into the piece of tubing at the top of the pillar and gives a fully swivelling seat. The top of the seat was covered with a piece of red material, rather like



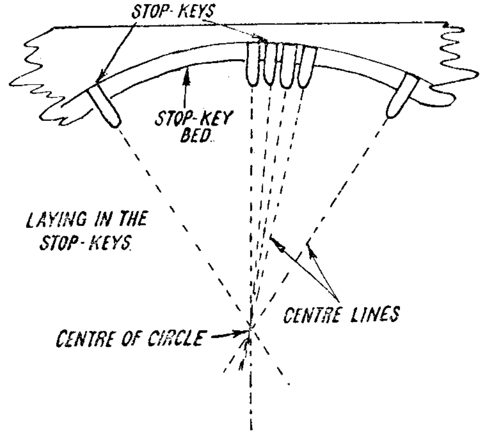
plush. The bottom of the seat pillar was glued and pinned to a " plate " of 3/32-in. cedar which slides under the rear of the pedal board.

The model is finished in glossy white with gilt trimmings. The pedals of the pedal clavier were left natural wood finish, the sharps and flats being painted black. The toe pistons are black with silver tops. The expression pedals are black with silver edging and the effects are silver. The lift button box and discus button box are both black with printing executed in white ink.

I do not claim this model to be a true replica of any particular console. I have only had photographs from which to work and, as mentioned previously, these were not good from the modelling angle. However, I have attempted to produce a typical Wurlitzer theatre organ console, and the opinion of many people who have seen the model is that I have succeeded. I have had a lot of fun building it and when I look at my " mighty Wurlitzer " I feel that all the headaches, trials and tribulations were well worth while. The building was spread over a period of a year—I worked when I felt so inclined and did not attempt to hurry.

I cannot close this article without acknowledging with grateful thanks the helpful hints and constructive criticisms given by Ray Baines, the well-known broadcasting organist. These have helped me to turn out a better model. I should also like to express my thanks to my friend, Bassett Stevens, for the time and great pains taken in producing some very excellent photographs of the model.

Organists, organ builders and others connected with the organ world will no doubt be critical of the manner in which I have described certain parts of the console. The majority of the readers of this article will, however, know relatively little about organs, and so as not to confuse them I have used non-technical terms wherever I have considered it necessary.



For the benefit of any superstitious members of the community I would mention that this is my *thirteenth* model organ console !

Mowing Without Blowing !

(*Continued from page* 81)

speeds are, of course, available. Due to the comparatively few hours of running the belt is called upon to do in a season, its life is not unduly impaired by the admittedly abnormal treatment it receives.

In carrying out this motorisation, it was felt that difficulties would arise in dealing with 30 yards of rubber covered flex when actually cutting the lawn. Three seasons of experience have proved these early fears to be imaginary. By adopting the simple routine of keeping the cable alternately on each side of the machine as one progresses to and fro, no difficulties or entanglements occur. Moreover, since only one hand is necessary to control the machine, the other is free to swing the cable out of the way should the need arise.

This is one of the simplest and cheapest ways of completely motorising a roller mower. Only a few parts are required, most of which are standard items, and their arrangement will be clearly seen in the photographs.

The mower has worked splendidly for the past three years, and is so easy to use that the longest grass can be cut by a lady with only one hand on the machine. The original parts are still in use, and show no signs of wearing out.

Model Power Boat News

by " Meridian "

Mr. A. W. Cockman with his new " C " class flash steamer " Ifit 8 "

THE special M.P.B.A. " Festival " Regatta held recently at Victoria Park, London, proved highly interesting and successful. Saturday was reserved for the free-running boats and on the Sunday the usual M.P.B.A. International programme was held.

The attendance on both days was very good, and in all, some 90 different boats took part in the regatta, about 45 on each day. The attendance of the straight-running boats was less than some recent Grand Regattas, but this was obviously due to this section of the regatta being run on a Saturday, when clubs who run a coach down find it difficult to muster enough members who are not at work.

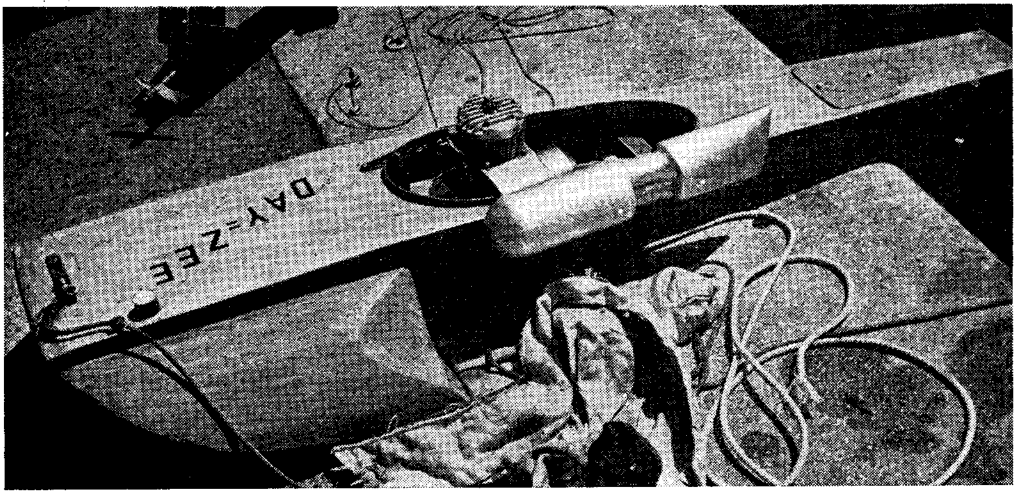
An entirely new event was a high spot in the proceedings on the first day. This was the Team Steering Contest, and it proved a most entertaining event for both spectators and competitors.

Free Running Events

A 75-yd. Nomination Race and an ordinary Steering Competition were held in addition to the Team Steering, and boats from about a dozen different clubs were taking part.

The winner of the Nomination Event, Mr. Hinton, of Cheltenham, was taking part in his first regatta with his air-sea rescue launch, and he returned an exact nomination for the distance! This must be almost a record—a win at one's first regatta, an achievement which must be quite heartening.

A striking prototype boat was Mr. Penny's oil-tanker *Helena*, now fully completed since its revious appearance at Victoria Park.

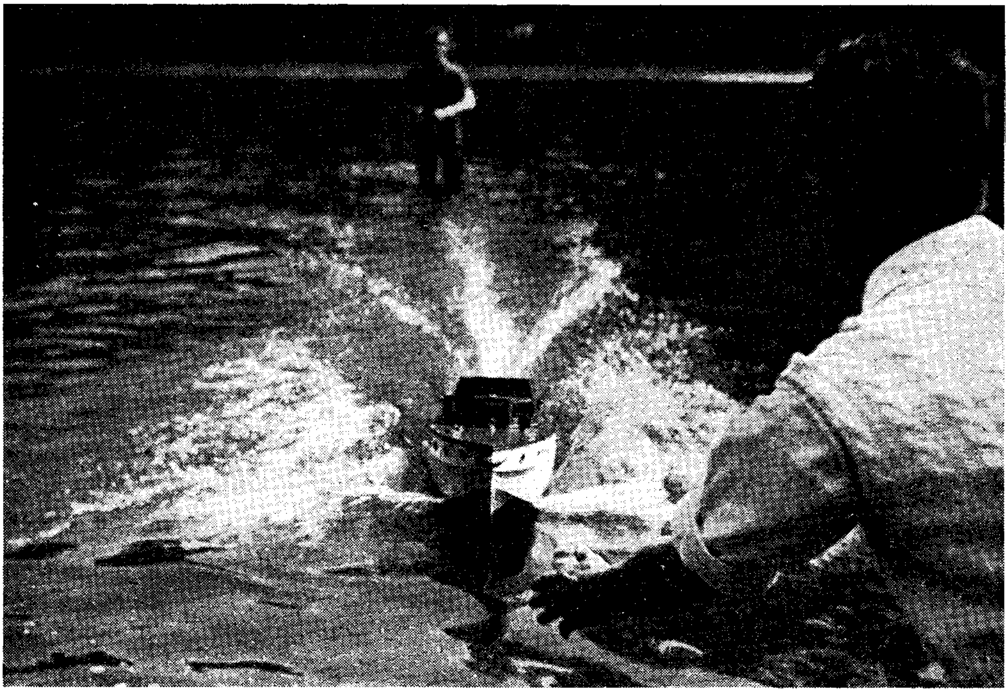


Study in silencers (1) *The two-stage silencers on Mr. Butcher's " Dayzee "*

In the Steering Competition, a cross-wind was responsible for many boats missing the targets. Some boats which have normally quite good steering qualities misbehaved badly on this occasion, but A. Rayman (Blackheath) scored 13 pts. with *Yvonne*, which was running well on form. A tie for third place between Bill Blaney and W. Starling, both of the Victoria Club, resulted in a re-run in which W. Starling's

1. Mr. Hinton (Cheltenham), *CT2*: error per cent. nil.
2. H. Whiting (Orpington), *Eileen*: error per cent. 0.24.
3. Mr. Angell (Croydon), *Mary*: error per cent. 0.53.

Steering Competition:
1. A. Rayman (Blackheath), *Yvonne*: 13 pts.



A straight shot by Mr. W. Starling's petrol-driven cruiser, "Pamela"

Pamela scored 3 as against Bill Blaney's *Lil' Man* nil.

The Team Steering Contest was for one team per club, the team consisting of three boats. In order to represent a club, the team had to have at least two genuine club boats in the team, but one "foreign" boat was allowed if a team could not be made up without.

Each team was set to score 27 pts., the boats taking one run each in strict sequence until this score was reached.

The contest proved to be a real test of teamwork, reliability and steering; for example, if a boat's engine stopped and it was the next one due to run, the team could not continue until it had been restarted and made its tilt at the target.

The team to make the least number of runs at the target while reaching the set score were the winners, but in order to prevent teams taking too long over the business, a time limit of 12 min. was in operation and this proved quite adequate, the winning team and the runners-up only taking about half of this time.

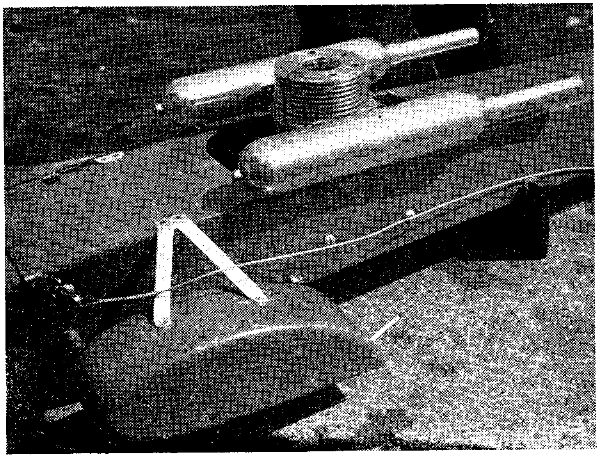
Results of Free Running Events—75 yd. Nomination Race:

2. E. Vanner (Victoria), *All Alone*: 10 pts
3. W. Starling (Victoria), *Pamela*: 8 pts (after re-run).

Team Steering Contest:
1. Victoria, Messrs. Morss, Phillips and Vanner: 8 runs.
2. Blackheath, Messrs. Clay, Rayman and Jepson: 9 runs.

On the following day the usual M.P.B.A. "International" programme was held, with races for Class "A," "B," "C" and "C" Restricted hydroplanes. Strictly speaking, only the Class "A" race for the International Trophy is open to foreign entries, and in view of the scarcity of 30 c.c. engined boats on the Continent it was hardly surprising that there were no entries from abroad, although Mons Suzor had hoped to come, but was unable to do so.

It has to be recorded that the weather, although very sunny on both days, was not ideal for circular-course racing. High winds were responsible for many capsizes, and under these circumstances it was no surprise that the best all round performances should come from the Class "A"



Study in silencers (2) *Twin parallel silencers on Mr. Ward's new " A " class boat*

boats—the heavyweights.

Event 1 was a five-lap race for the "Wembley Trophy," and the "C" Restricted entry totalled 15, although six of these were 5 c.c. boats.

G. Stone (Kingsmere) running two boats—*Bill Barnes* and *Lady Babs II* in this race could not beat his Victoria Park hoodoo. Both of these boats capsized at very high speeds, the cause in one case was "flipping" backwards when the choppy water caused the boat to bounce and allowed air to build up on the underside.

This fate overtook many competitors craft, both in this and subsequent events, and in fact only six boats returned a time in this "C" Restricted race. S. W. Poyser (Victoria) made history by taking first and second places in this race, recording 43.3 m.p.h. with *Rumpus* 3, and 40.42 m.p.h. with *Rumpus* 2. Third place went to a "D" class boat—W. Everett's *Sno*, 37.46 m.p.h. The other competitors to complete the course were Messrs. Butcher (Victoria), Pinchin (Blackheath) and W. Everett's other entry *Jaffa*.

Some seven entries contested the Miniature Speed Championship for Class "B" boats. A welcome entry was F. Jutton's *Vesta II* which has been absent from regattas recently, while new hull experiments have been tried. As these experiments have not been very successful, *Vesta II* appeared in her old form and managed to record 46.5 m.p.h. This run led the field for some time until G. Lines (Orpington), after a spectacular capsize on the first run, recorded 53.6 m.p.h. with *Sparky II*, thus retaining the cup for the second year in succession.

R. Mitchell (Runcorn) ran two boats, *Beta II* and *Beta III*, but the latter is still suffering from the teething troubles that seem to be the lot of most hydroplanes in the early stages of development.

Beta II made one very good run, just failing to beat *Vesta II* by 0.5 m.p.h. T. Dalziel (Bournville) had to withdraw *Naiad II* owing to engine trouble, and this fate also befell N. Hodges (Orpington) with *Sparta*.

The "Wico-Pacy" Cup Race for Class "C" boats came next and some 12 boats were entered including a new baby flash steamer, *Ifit* 8 by A. Cockman (Victoria). R. Mitchell (Runcorn) with *Gamma* led the field with a run of 41.6 m.p.h. for some time, until the very last boat to compete, L. Pinder's *Rednip*, did 42.5 m.p.h. This win breaking an unluck spell for this boat. The record holder in this class—R. Phillips' *Foz II* petered out on the first run and capsized on the second attempt, and this also happened to C. Stanworth's *Mephisto*—a nicely made boat built this year.

A. Sherwood's diminutive *Jinx*, having an engine of only 2½ c.c., managed to take third place at a speed of 35.7 m.p.h. A fine performance for such a small boat.

The final event was the International Race for the Class "A" boats, and here the entry was some 10 boats. A most exciting race resulted since most of the entries managed to stay on top of the water.

K. Williams *Faro* was running well taking only 18.8 sec. for the five laps, (54.4 m.p.h.) and several boats roared round the course trying to better this. A. Cockman's *Ifit* 7 showed what flash steamers could do, recording 51.3 m.p.h., and E. Clarke with *Gordon* 2 failed by 0.03 sec. to equal *Faro's* performance!

S. Clifford of *Chatterbox* fame put in a couple of good runs with *Blue Streak*, the best at 41 m.p.h. J. Ward (Orpington) was unlucky not to complete with the twin-propeller boat *Kali.*

Full Results of Speed Events

(1) *Wembley Trophy for " C " Restricted Hydroplanes.* 500 *yd.*

1. S. Poyser (Victoria), *Rumpus* 3: 43.3 m.p.h.
2. S. Poyser (Victoria), *Rumpus* 2: 40.42 m.p.h.
3. W. Everett (Enfield), *Sno*: 37.46 m.p.h.

(2) *Miniature Speed Championship. Class " B " Hydroplanes.* 500 *yd.*:

1. G. Lines (Orpington), *Sparky II*: 53.6 m.p.h.
2. F. Jutton (Guildford), *Vesta II*: 46.5 m.p.h.
3. R. Mitchell (Runcorn), *Beta II*: 46 m.p.h.

(3) *Wico-Pacy Cup. Class " C " Hydroplanes.* 500 *yd.*:

1. L. Pinder (Kingsmere), *Rednip*: 42.5 m.p.h.
2. R. Mitchell (Runcorn), *Beta II*: 41.6 m.p.h.
3. A. Sherwood (Victoria), *Jinx*: 35.7 m.p.h.

(4) *International Race for Class " A " Hydroplanes.* 500 *yd.*:

1. K. Williams (Bournville), *Faro*: 54.4 m.p.h.
2. A. Clarke (Victoria), *Gordon* 2: 54.3 m.p.h.
3. A. Cockman (Victoria), *Ifit* 7: 51.5 m.p.h.

Novices' Corner — The Lathe V-tool

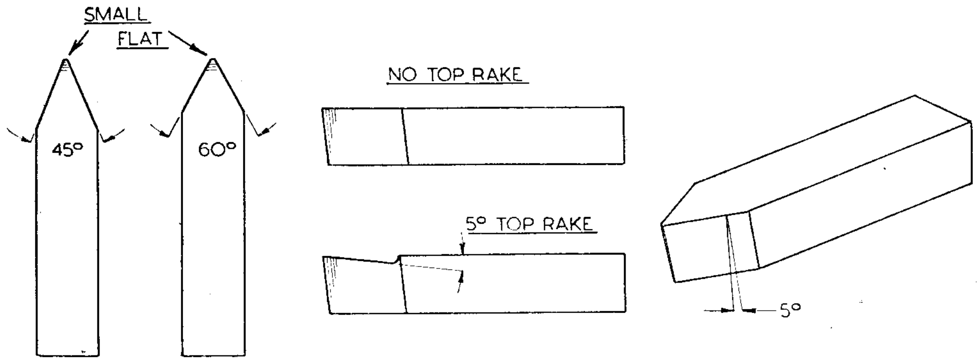


Fig. 1

THE V-tool has so many uses in ordinary turning operations that it may well be given a permanent place in the four-tool sliderest turret now commonly fitted to small lathes. Two of the remaining slots in the turret will probably be used to mount roughing and finishing tools for straightforward turning. This leaves a vacant place for a boring tool which is, perhaps, best mounted in the turret only when required, as the projecting part of the shank is apt to get in the way and foul the chuck jaws while other tools are being brought into position.

Two examples of V-tools are shown in Fig. 1, and the value of the included angle at the tip will vary according to the purpose for which the tool is used. For turning brass, the upper surface of the tool is usually made flat, but steel is machined more freely if, as shown, a top rake of some 5 deg. is given to the tool. The side clearances are restricted to approximately 5 deg. in order to maintain the strength of the tip; in addition, for most purposes it is advisable to hone a small flat at the point of the tool so as to make the extreme tip less fragile.

Although a tool with a 90 deg. or 60 deg. point will serve quite well for chamfering washers and bolts heads, the work will have a better appearance if the more usual chamfering angle of 40 deg. is used; for this purpose either the tool tip is formed to an included angle of 80 deg., or the turret is rotated to set the cutting edge of the tool to approximately the correct angle.

When machining chamfered collars, similar to that depicted in Fig. 2, the outer end of the work is chamfered and the parting tool is then entered for a short distance, as shown in Fig. 2B, before the collar is finally parted off to length. This will enable the second chamfer to be formed with the V-tool, as represented in Fig. 2C.

It is the usual practice to form a flat seating for a cheese-head screw as shown in Fig. 3; but an end-mill or a counter-bore of the correct size may not be available for finishing the drill hole in this way. Where a screw is made for a special purpose, the under side of the head can be machined to the form shown in Fig. 4 by using a 60 deg. V-tool, and the included angle left on the work will then be equal to 120 deg. If now the hole to receive the screw head is drilled with an ordinary twist drill, having a point of 118 deg., a reasonably good seating will result when the screw is fully tightened. A better fit will, of course, be obtained if the turret is slightly rotated so as to set the side face of the V-tool

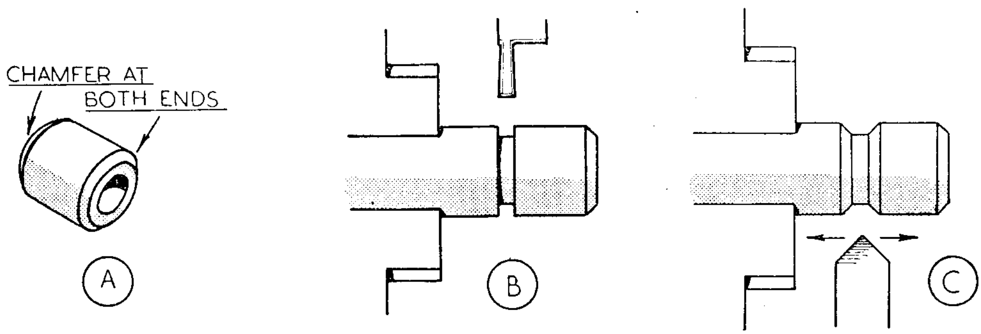


Fig. 2

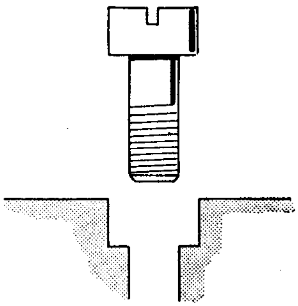


Fig. 3

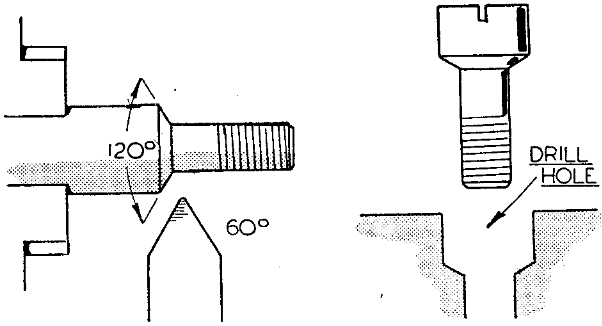
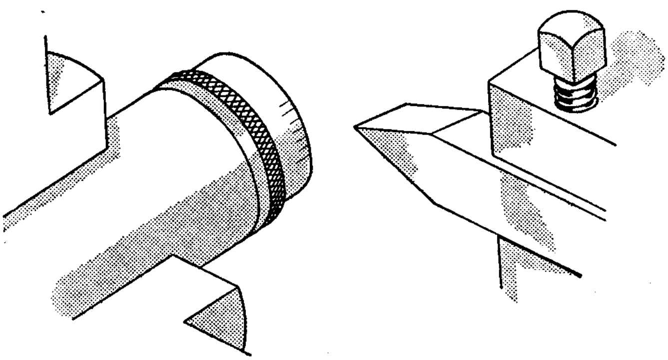


Fig. 4

at exactly the corresponding angle to the work.

One of the most useful applications of the V-tool is cutting graduation lines on such parts as the index collars fitted to the feed screws of machine slides. For this purpose, as represented in Fig. 5, the tool is mounted on its side and set at exactly lathe centre height. A tool with a 60 deg. point will serve well, but finer and deeper lines can be cut with a 45 deg. tool; care must, however, be exercised when using the tool with the more slender tip, and only light cuts should be taken in order to avoid breaking off the fine point. To counteract any tendency for the tool to dig into the work, either a tool without top rake should be used, or the turret may be slightly rotated so that the front face of the tool stands at right-angles to the work surface.



Left—Fig. 5

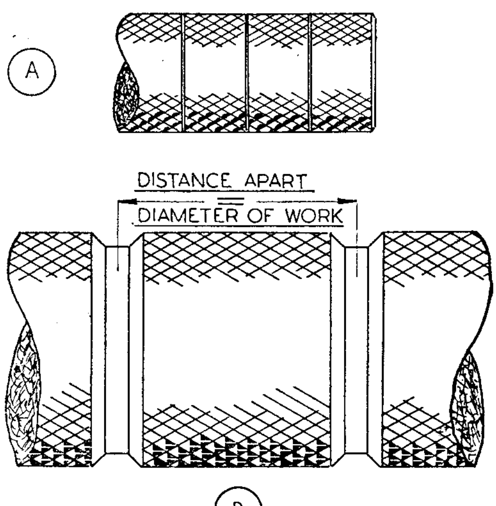
A more pleasing and workmanlike appearance is given to some knurled parts by machining one or more shallow grooves on the surface. As illustrated in Fig. 6A, this can readily be done by feeding a V-tool directly into the work for a short distance.

Where the part is of large diameter, however, the appearance may be enhanced, as shown in Fig. 6B, by turning a rather wider groove with flat bottom and bevelled sides. To do this, the tool is first fed inwards for a short distance and is then traversed a little to either side until the desired effect is produced.

When turning a series of grooves in this way, equal spacing is, of course, essential if the work is to look right. The grooves should, therefore, be accurately located by using the leadscrew index as a guide for traversing the tool along the work; moreover, when a groove has to be widened, the tool must be moved for an equal distance on either side of the groove centre by again making use of the leadscrew index.

As V-tools are not generally employed for

Below—Fig. 6



taking heavy cuts, they can quite well be made from material of small cross-section, such as ¼ in. square tool-steel. There are, however, several brands of special high-speed steel made for this purpose and supplied in short lengths ground on all faces.

The "Eclipse" tool-bits can be obtained with the two ends formed at an oblique angle, and this may save much grinding when making special tools such as V-tools. V-tools should always be ground with the aid of an adjustable, angular grinding rest, so that the side faces are formed truly flat and will thus machine corresponding well-finished flat surfaces on the work.

Waterproof Adhesives

by P. W. Blandford

ORDINARY carpenter's glue soon gives way in damp conditions. Casein glue has a limited damp resistance, but it will give way if allowed to become really wet. Cellulose cements, with the "pear-drop" smell, are waterproof, but they are not strong enough for constructional woodwork; although they can be used for light jobs, such as model aircraft construction.

For any wood construction which has to resist dampness, the most suitable glues are those which are collectively termed "synthetic resin glues." Even for work where resistance to dampness is not a consideration, they may be preferred to the old-fashioned wood glue, because of their ease of application and great strength. They will produce joints which are stronger than the wood, waterproof even to boiling water, and heat-proof.

Synthetic resin glues are not particularly "sticky" in the normal sense. There are a number of types, but their effects, from the practical point of view, are very similar. All are supplied in two parts—the glue proper and an accelerator, which hardens the glue when added to it. Varying strengths of hardener are usually available. These can be used to allow setting times between minutes and days. The glues supplied in a syrup form have limited keeping qualities. Because of this rather short "shelf life" it is unwise to order more than is required for a month or two use. Glues supplied in powder form will keep for at least a year. Accelerators will keep indefinitely.

There are many manufacturers of synthetic resin glues, supplying industry with large quantities, but not all of the firms are willing to supply the comparatively small quantities needed by amateurs. Because of the shelf-life limitations, retail shops are not keen to stock these glues. There are, however, an increasing number of manufacturers prepared to cater for the smaller users. All of the glues mentioned in this article have been tested by the writer and found to be satisfactory. There is no particular priority in the order they are mentioned.

Instructions accompany the glue, but the following points apply to all glues. Do not use metal containers for mixing or metal-bound brushes for applying, as this may cause staining of some woods. The accelerator begins to harden the glue as soon as they meet, so that adjustments should be made quickly (normally within 10 minutes). Then the job cramped and left for the prescribed time. Some glues are "gap-filling"—m king as strong a job of a badly-fitting joint as of a carefully cut one!

Aerolite. Made by Aero Research Ltd., Duxford, Cambridge. This is a white glue which is applied to one surface, and a clear liquid accelerator which is applied to the other surface. The parts are brought together, adjusted within 10 minutes, and cramped until set. Setting time varies with temperature, but leaving overnight is advisable. Aerolite 300 is the general purpose glue, supplied as a syrup with a shelf-life of about three months. Aerolite 301 is similar, but less runny. Aerolite 306 is supplied as a powder, with a much longer life, which is mixed to form a syrup similar to 300: powder 1 lb., water 1/3 pint, methylated spirits 1/20 pint. Price: 4 oz., 3s.; 8 oz., 4s. 6d.

Casco-Resin. Supplied by Charles Cleeve & Co. Ltd., 45, Great Peter Street, London, S.W.1. This is supplied as a syrup which may be used with a separately-applied accelerator, as with Aerolite, or with a "combined" hardener which is mixed with the syrup just before use. The general-purpose glue is Casco-Resin "H" (a syrup with a shelf life of a few months) which can be used for close-fitting joints with hardeners K6, K7 or K8, which have setting times at 60 deg. F. of five hours, 3¼ hours and 25 minutes respectively. Combined hardeners, with similar setting times are M22, 23 and 24. A gap-filling glue, for badly-fitting joints is Casco-Resin G101 with combined hardener No. 1. All glues (with sufficient hardener) are the same price: ½ lb. at 2s. 6d.; 1 lb. at 3s. 6d.; 2 lb. at 6s. 6d.

G118 and 119. Made and supplied by Newman & Staff Ltd., Dome Buildings, Richmond, Surrey. This is supplied as a powder, with a shelf life of at least a year, which is used with a separate liquid hardener. The setting time is a few hours, depending on the temperature. Mix the powder to form a resin in the proportions: powder 18 parts, water 7 parts and methylated spirit 2 parts. This will keep for about a week. Apply glue to one part, hardener to the other, then bring together and cramp until set. Prices: G118 resin glue powder at 4s. 4d. per lb., G119 liquid hardener at 2s. 2d. per half pint.

Resorcinol. Supplied by Handicraft Supplies Ltd., 204a, Gower Street, London, N.W.1. This differs from the other glues in being a dark red syrup with a powder hardener which is mixed with the syrup before use. Price: 3s. per pot. This glue may be used in the same way as the others, but it is also particularly suitable for building up paper laminations, or for making small plastic castings, using the glue alone as the casting material. It is also one of the very few adhesives which will join Perspex to Catalin, but its dark red colour makes it unsuitable for use with clear Perspex, when appearance is a consideration.

*" That Wonderful Year . . . . ."

by " The Dominie"

WELL-KNOWN builders of marine engines are John Penn & Son, of Greenwich, and they are showing both working

*Continued from page 61, " *M.E.*," *July* 12, 1951.

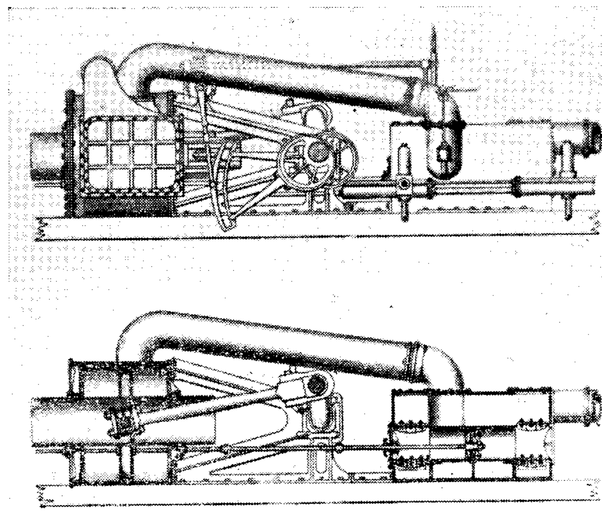


Fig. 32. *John Penn's trunk-type marine engine, with annular piston attached to sliding trunk, an arrangement which led to certain loss of heat, as the trunk was alternately exposed to steam and outer air*

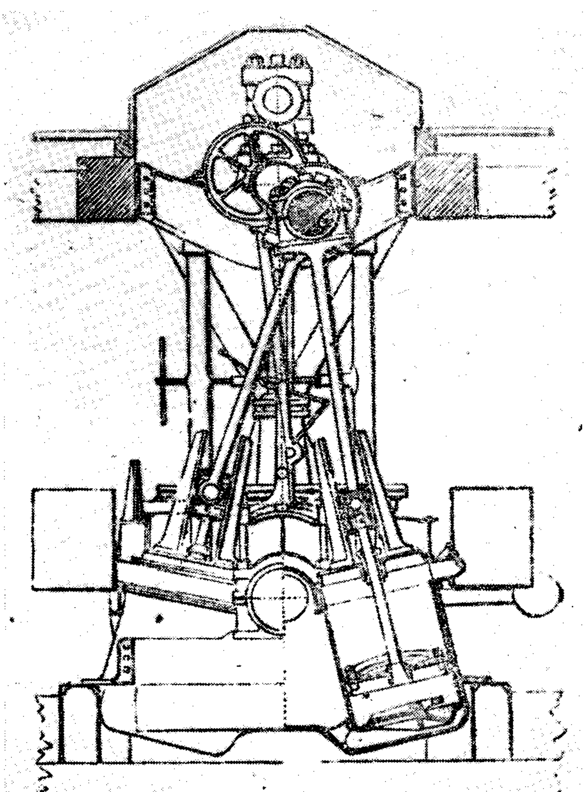


Fig. 33. *Cross-section through Penn's oscillating engine at one of the air-pumps. The crank of the cylinder beyond is at t.d.c.*

models and prototypes on Stand 8. Their patent trunk engines, as fitted to Her Majesty's steam-frigate *Arrogant* and steam-sloop *Encounter*, are demonstrated by a working model (Fig. 32). Of 360 horse-power, there were two cylinders of 55 in. diameter and 3 ft. stroke in the prototype. As we see, the piston carries a trunk which slides through large stuffing boxes in the cylinder covers, and in this manner a long connecting-rod can be used while at the same time the overall length of the engine is kept down. The condensers are placed on the opposite side of the crankshaft, with air-pumps driven direct from the pistons. A full-sized two-cylinder engine of 60 h.p. is shown also.

Penn's also build oscillating engines, and Fig. 33 shows a section of one of the air pumps. Two working models of this type of engine, and a small (24 h.p.) prototype are on the stand. The principle is the same, of course, as that of the Maudslay oscillating engines already described.

Even in our own time, the term " McNaughting " will be heard occasionally on the lips of old an " engine-tenter " in northern mills, though it will be a mystery word to many modern readers. However, we now have a chance to see an engine which has undergone this treatment, for William

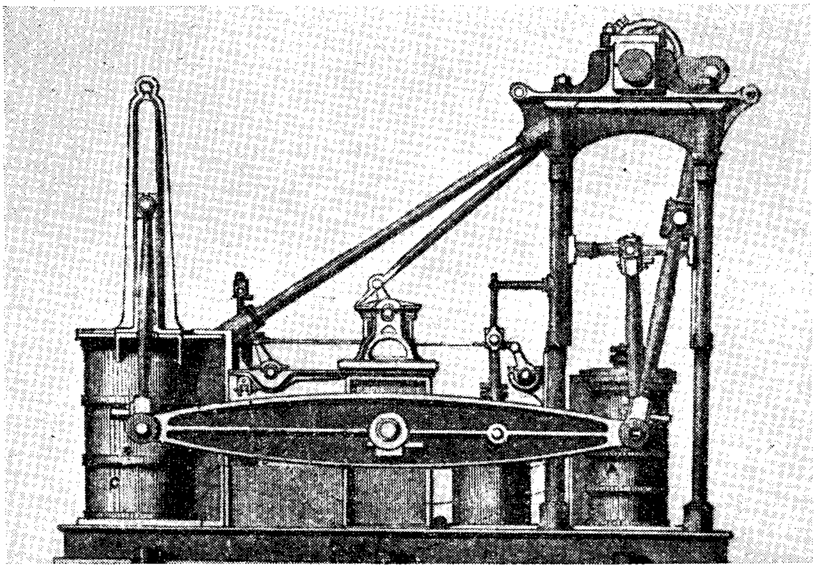


Fig. 34. William McNaught's compounding arrangement applied to a side-lever engine, with high-pressure cylinder added under crank

McNaught, of Glasgow, Inventor, has Stand No. 22 at this magnificent show. Briefly, his invention is an adaptation of compounding to give increased power to engines originally constructed for working with low-pressure steam—you will realise that many of the early steam engines worked at pressures little above that of the atmosphere! Even in 1851 (and later), higher pressures are regarded with suspicion in many circles! McNaught's idea is to add a higher-pressure cylinder to a beam engine, at the opposite end to the original cylinder; the steam exhausts from the H.P. to the L.P. cylinder and thence in the ordinary way to the condenser, so using the expansive power of the steam to the utmost. In addition, the beam is "balanced," so to speak, and vibration lessened, but the power is greatly increased.

And now McNaught shows his principle applied to the "inverted-beam" or side-lever engine, with the H.P. cylinder under the paddle-shaft. From its crosshead side-rods drop to the side-levers, from whence the drive is taken to the crank by a forked connecting-rod (Fig. 34). The L.P. cylinder acts on the other ends of the side-levers, through the usual return connecting-rods. Note, by the way, that the crosshead is guided by slide-bars instead of modified Watt's parallel motion, which is the more popular method in this type of engine.

"Disc" engines of many makes are on view—there have been dozens of patents on this subject in the past few

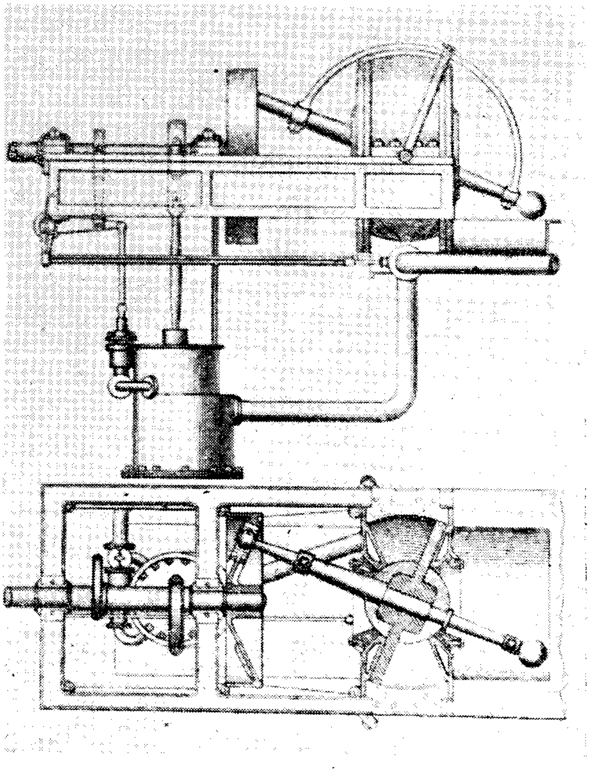
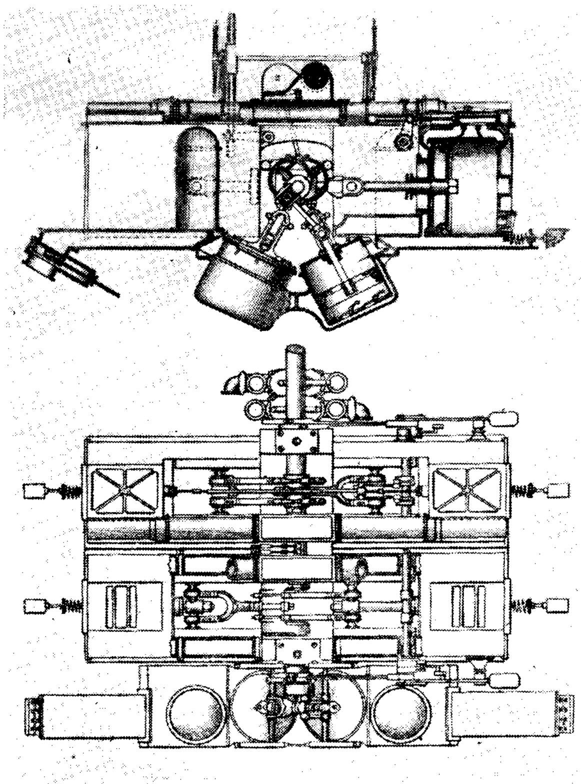


Fig. 35. The disc engine, improved by Bishopp and built by Rennie, was used in workshops before marine propulsion. The original invention was by Taylor and Davies in 1836-38



years—and the well-known firm Rennie has taken up Bishopp's patent (Fig. 35). The disc-shaped piston oscillates in a chamber which is part of a sphere, and not a cylinder at all, communicating its motion to the " crankshaft " through a rod passing through its centre. The advantages claimed in the catalogue for this system are (i) half the bulk and weight of the ordinary types ; (ii) three times the number of revolutions for the same piston speed ; and (iii) expansion better utilised. The disadvantages, which the makers do *not* mention, are first, the somewhat intricate machining problems, and second, difficulty in maintaining everything steam-tight. Nevertheless, a very interesting model.

Among the other models on Rennie's stand are a set of four-cylinder direct-acting marine-engines (Fig. 36), in which the pairs of cylinders are horizontally opposed, and work direct on to the central crankshaft through forked and double connecting-rods. To keep the overall dimensions down, the stroke is very short, being less than half the bore. A crank on the forward end of the shaft drives the two air-pumps, and the slide-valves are driven through rocking-levers from eccentrics outside the main bearings, the opposed valves being connected to each other by a single rod, and so driven from the same pair of eccentrics.

(*To be continued*)

Fig. 36. *In Rennie's four-cylinder screw engines, the cylinders were direct-acting and in horizontally-opposed pairs. The elevation shows a section through one cylinder and one of the air-pumps*

" PARTING OFF "

by N-5-West

FOR many a day the operation of " parting off " was a trouble to me, especially if the piece to be cut exceeded, say, 1 in. diameter My difficulty was overcome, however, by devising a holder for the " parting " section tool-steel which will be familiar to most model engineers. I have used this tool now for many months and find it entirely satisfactory. The sketch will make the device clear. Dimensions will, of course, depend upon individual requirements. Overhang is adjustable. When parting hex. sections—for nuts—I occasionally set the steel with excessive overhang, thus " fluttering " the cutter and producing an ornamental effect.